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A Consolidation of Engineering News, Engineering Record
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Next Week
Rockefeller Center

The planning, design and construction phases of this significant group-building development, also known as Radio City, will be presented in six articles. Covering 12 acres of valuable real estate in mid-town New York, including among its units tall skyscrapers and large theaters and involving many new ideas and concepts, Rockefeller Center, as portrayed in this issue, should have universal appeal.

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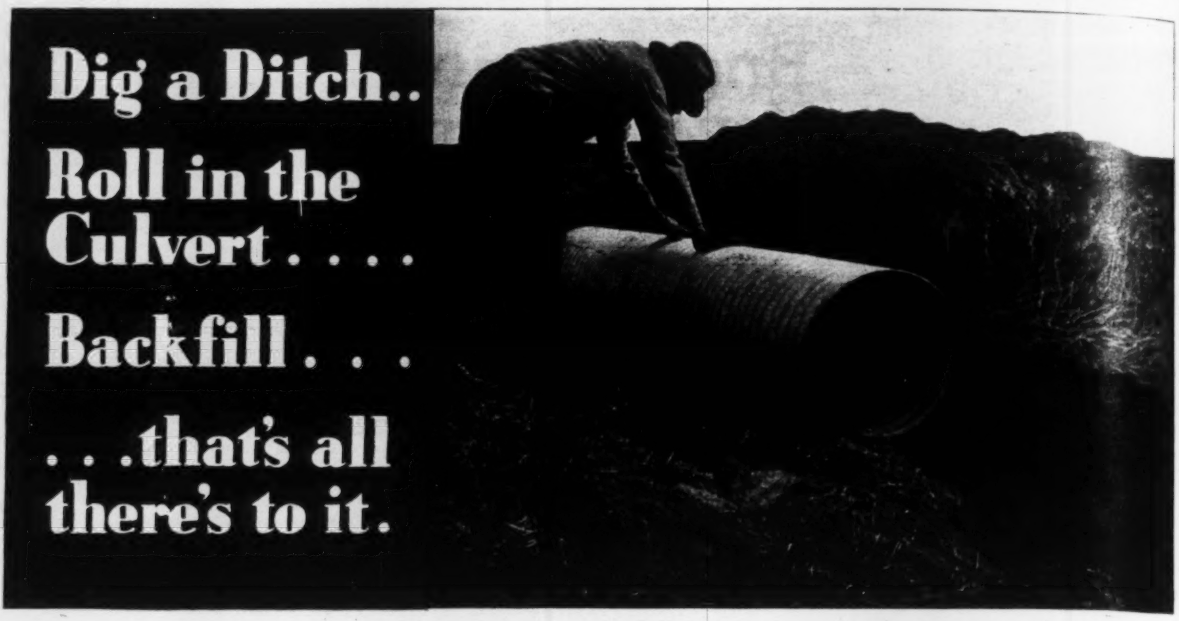
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Engineering
News-Record

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Building Facade Emphasizes Steel Frame

Philadelphia Savings Fund Building, in addition to presenting a new architectural concept, is structurally important, including cantilever walls and 60-ft.-span trusses carrying upper 30 stories

THE DUAL distinction of being the tallest building in Philadelphia and one of the most unique of modern structures in design and appearance belongs to the Philadelphia Savings Fund Society Building. Owned and partly occupied by the oldest savings-bank institution in America, this 33-story building incloses a volume of about 8,000,000 cu.ft., has a floor area of 560,000 sq.ft., and cost about $8,000,000. Architecturally, it is notable for its special grouping of bank quarters, office space and service facilities, for an absence of columns and attendant vertical lines in the front facade, for a facade on the two sides of the building in which the outline of the steel frame is reproduced in the inclosure materials and in general for the attempt made to create an efficient building that would reflect its character and function as a machine. Structurally, the building is noteworthy for the large banking room on the second floor, 130 ft. long and 60 ft. wide, spanned by trusses that carry the upper 30 stories of the building, for the unique make-up of these trusses, for the wind design that considered these trusses and their supporting columns as a rigid frame, for cantilever construction on the front wall, and for a complicated framing layout that carries the show windows of the sidewalk shops several feet outside the column lines at the front corner of the building.

Fig. 1—Column pilasters in relief on the side faces and cantilever walls on the front face lend a new architectural note to the 33-story Savings Fund Society Building, tallest office structure in Philadelphia.

The ground-floor plan of the building is a rectangle 132 ft. on Market St. and 164 ft. on 12th St., but above the sixth floor level areas on either side are discontinued so that the prevailing shape is that of a T. In the stem of this T, which is 63 ft. wide by 132 ft. long, are concentrated the offices and banking rooms, while the head of the T is devoted largely to service facilities such as elevators, stairs, flues and duct shafts. The dimensions of the stem of the T outline the banking room on the second floor, spanned by seven double trusses 16½ ft. deep. The fourteen columns supporting these trusses carry the load of the entire stem of the T. Of the 11,000 tons of steel in the building, 5,600 tons is utilized in columns and 750 tons in trusses.

According to the architects, Howe & Lescaze of New York City, "The banking quarters on the second and third floors are emphasized by their scale and a covering of polished granite as the dominating note in the composition. The entrances to the banking quarters and office-building lobby are placed off center in the extreme corners of the property so as to leave the stores on the first floor and the banking room on the second floor entirely available for use. The banking room on the second floor is reached by a stair, two elevators and two escalators. The wide band over the banking-room window is the envelope of the large trusses that carry the tower. These form the bony structure of the 'lung cavity' where the ventilating machinery for the building is housed. The legs on which the building is balanced may be seen through the light skirt of plate glass which forms the bulkhead windows of the stores at the sidewalk level. The vertical tower of black glazed brick at the rear contains the vertical circulation of the building. To it, ribs marking the horizontal floors of the office tower and made of gray matt glazed brick are attached. The air throughout the rentable area of the building is cooled and dehumidified in summer, thermostatically controlled and humidified in winter."

Among the other architectural features of the building are double-hung aluminum windows, stainless-steel flush doors in the lobby, terrazzo floors in corridors and lobbies, concrete floors with integral coloring in the service areas, concrete floors with integral coloring in the service areas, concrete floors with colorless hardening in the tenant areas, concealed fin-and-tube type radiators, copper-bearing-steel heat piping, brass hot and cold water piping, radio outlets and thermostatic heat control.

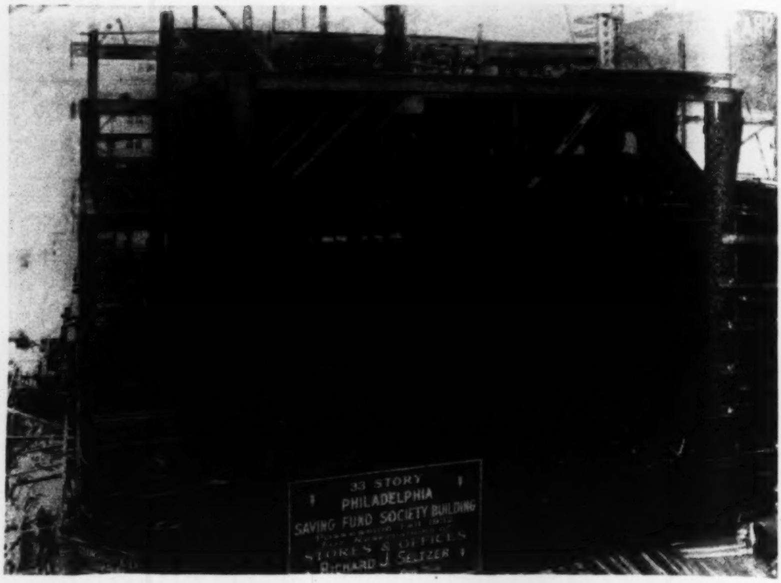
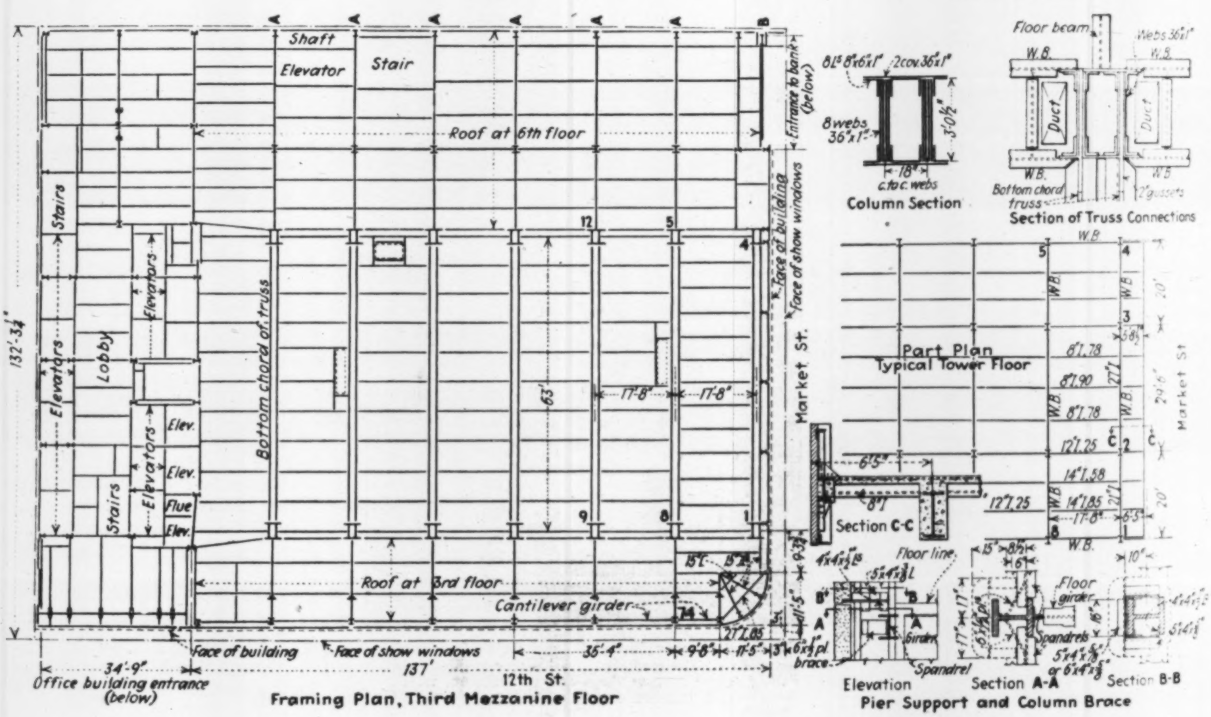

33 STORY
PHILADELPHIA
SAVING FUND SOCIETY BUILDING
STORES & OFFICES
RICHARD J. SELTZER

Fig. 2—Truss-framed bents designed as rigid frames carry 30 upper stories of building over banking room 60x130 ft. on the second floor. Truss gussets are milled to bear on web plates of supporting columns and on base billets of columns carried above.

In addition to the structural features in the main portion of the building, the framing used to support the store fronts along the 12th St. face is noteworthy because of the desire for wide column spacing and the necessity for carrying the unusually heavy load of granite facing. On the front corner there is no column, and a complicated cantilever framing layout results. At this point a 40-ft. length of store front (from col. 74 on the 12th St. side to col. 1 on the Market St. side) is devoid of column support. The framing at this corner (between the show-window head and the second floor) is shown on the plan, Fig. 3, and in the photograph, Fig. 5. Briefly, it consists of a 27-in. 85-lb. beam forming a chord of the circular arc, carried at one end by an inclined hanger from col. 1 and at the other by a plate girder that cantilevers 9 ft. 8 in. beyond col. 74 (Fig. 6). Pairs of 15-in.

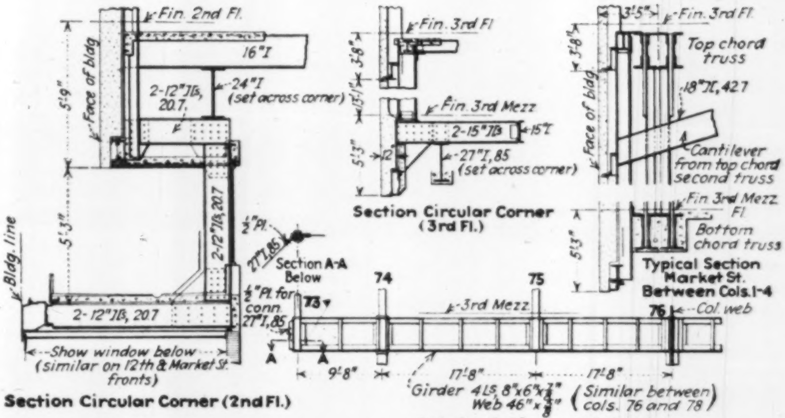
Fig. 3—Prevailing shape of building above sixth floor is that of a T, with offices in stem and service facilities in head. Plan shows cantilever framing on Market St. front and wide column spacing in store fronts along 12th St.


Shaft
Elevator
Stair
Roof at 6th floor
Entrance to bank (below)
Face of building
Face of show windows
Stairs
Elevators
Lobby
Elevators
Elev.
Elev.
Elevators
Stairs
Flue
Elev.
Bottom chord of truss
12
5
4
9
8
1
63'
17'-8"
17'-8"
Market St.
132'-3¾"
Roof at 3rd floor
Cantilever girder
74
27"I.85
9'-3½"
11'-5"
34'-9"
Office building entrance (below)
Face of building
Face of show windows
137'
35'-4"
9'-8"
11'-5"
3'
6x½" pl brace
12th St.
Framing Plan, Third Mezzanine Floor
8Ls 8"x6"x1"
2cov. 36"x1"
8 webs 36"x1"
3'-0½"
18" c. to c. webs
Column Section
Floor beam
Webs 36"x1"
W.B.
Duct
Duct
W.B.
Bottom chord truss
2" gussets
Section of Truss Connections
Part Plan Typical Tower Floor
W.B.
5
4
3
2
8
8"I.78
8"I.90
8"I.78
12"I.25
14"I.58
14"I.85
12"I.25
27"I
21"I
20'
5'-8½"
24'-6"
20'
17'-8"
6'-5"
C
C
Market St
6'-5"
8"I
Section C-C
4"x4"x½" Ls
5"x4"x⅜" L
Floor line
B
B
A
A
Girder
Spandrel
15"
8½"
6"
17"
17"
Floor girder
Spandrels
5"x4"x⅞" or 6"x4"x⅝"
16"
10"
4"x4"x½"
5"x4"x⅜"
Elevation
Section A-A
Section B-B
Pier Support and Column Brace

channels placed radially over the 27-in. beam carry short columns on their ends that extend to the parapet of the granite facing just above the third floor.

A similar, although lighter, framing arrangement is used at the second-floor corner. As shown in Fig. 6, a marquee roof over the sidewalk is also carried from this second-floor framing. On the Market St. front the facing is hung outside the main steel supports from inclined cantilever beams (Fig. 6).

The stem portion of the T-shaped building contains the main features of structural interest. The banking room, in the central portion of which no interior columns were permitted, being on the second floor, high wide-span bents were required from the basement to the third floor. These bents are spanned below the third floor by deep and heavy double trusses that carry the upper 30 stories of the building. In addition, shallower double trusses carrying the first and second floors, and girders carrying the basement floor serve to brace these bents against wind and reduce the unsupported length of the columns. Above the third floor two interior lines of columns are introduced, carried on the top chords of the trusses. Since the columns supporting the trusses are inclined outward in the truss depth a distance of 3 ft. 3 in., the width of the upper part of the building is 69 ft. 6 in. as compared with 63 ft. in the banking room and below. This 69 ft. 6-in. width is divided into three bays—two of 20 ft. on the outside and a central bay of 29½ ft. The depth of all bays is 17 ft. 8 in.


Section Circular Corner (2nd Fl.)

Section Circular Corner (3rd Fl.)

Typical Section Market St. Between Cols. 1-4

Detail of Girder (12th Fl.)

Fin. 2nd Fl.
16"I
5'-9"
Face of bldg
2-12"[s, 20.7
24"I (set across corner)
5'-3"
2-12"[s, 20.7
½" Pl.
27"I, 85
Section A-A Below
Bldg. line
½" Pl. for conn.
27"I, 85
2-12"[s, 20.7
Show window below (similar on 12th & Market St. fronts)
Fin. 3rd Fl
3'-8"
13'-1½"
Fin. 3rd Mezz
2-15"[s
15"I
5'-3"
12
27"I, 85 (set across corner)
3'-5"
Fin. 3rd Fl
3'-8"
Top chord truss
Face of bldg
18"[, 42.7
Cantilever from top chord second truss
Fin 3rd Mezz Fl
Bottom chord truss
5'-3"
74
75
73
76
3rd Mezz
Col. web
A
9'-8"
17'-8"
17'-8"
Girder 4Ls, 8"x6"x⅞" Web 46"x⅝"
(Similar between cols. 76 and 78)

Fig. 6 — Details of store-front framing, which is to a large extent carried outside the column lines.

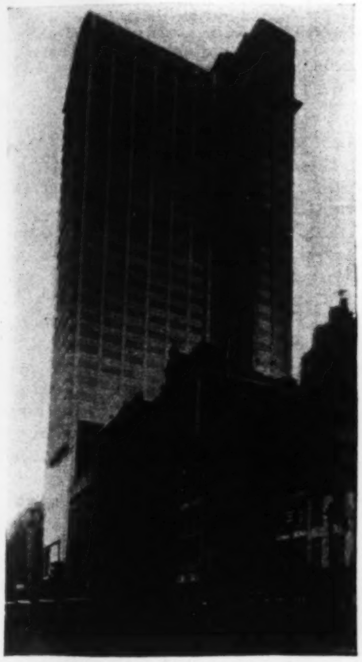


Fig. 4—In the completed building the rear wing, containing the service facilities and some offices, is inclosed in darker brick than the main-office portion in which the columns appear in relief except on the front facade, which is devoid of all columns.

Wind Design

Wind design in a building of this character—30 stories on a three-story frame of 63-ft. span—is unusually important. The three-story lower portion of each bent was designed as a rigid frame. In the upper stories kneebraces are used at every girder-to-column connection, as shown in Fig. 7. These knees permitted full continuity to be developed in the girders, which was not practicable with split-beam connections. The design was based on the cantilever method of shear distribution in the bents with web deflections controlled to insure floors remaining plane after bending. Connection design was studied for continuous action of members under dead and live load as well

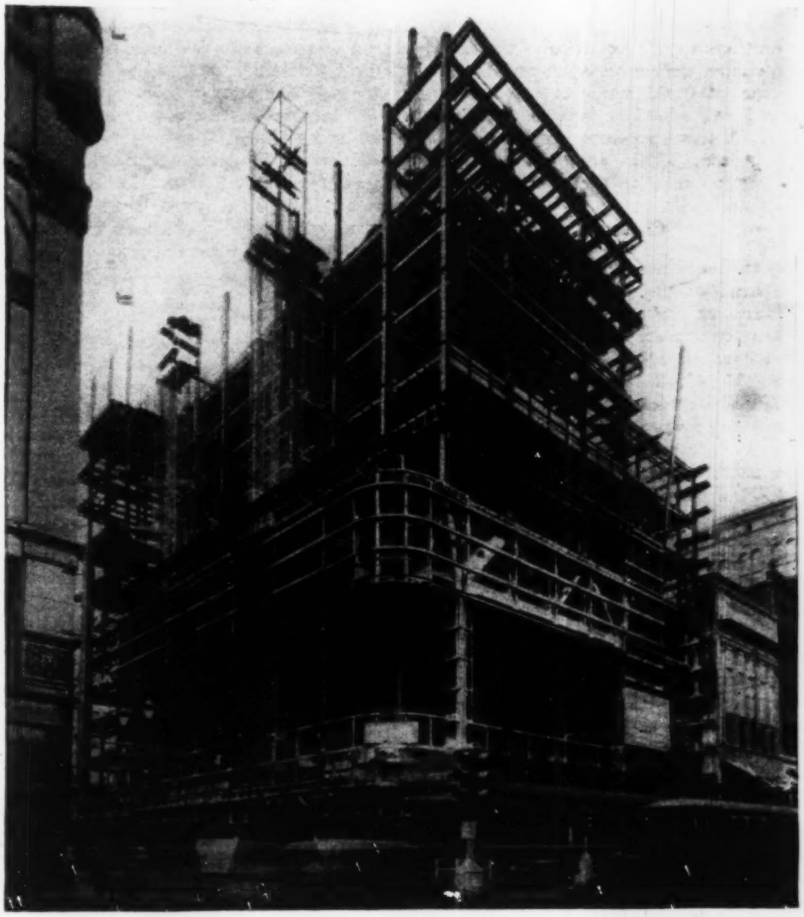
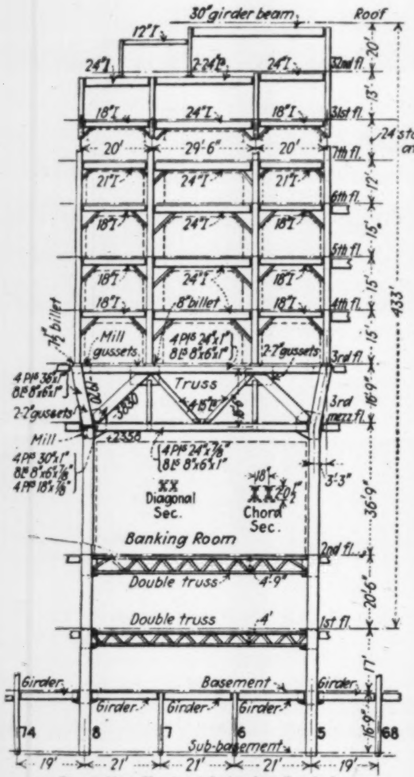
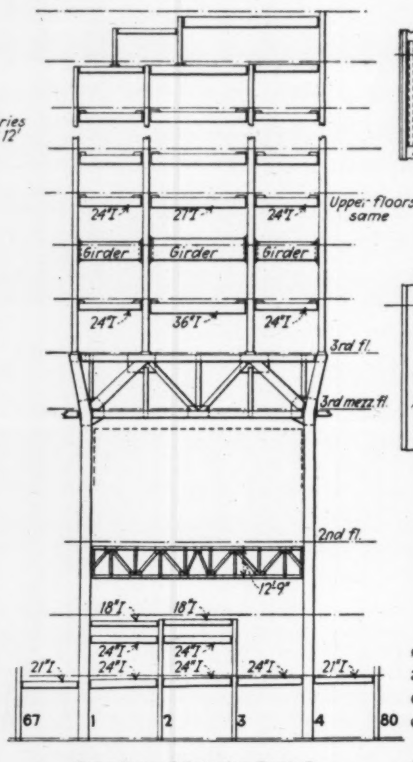


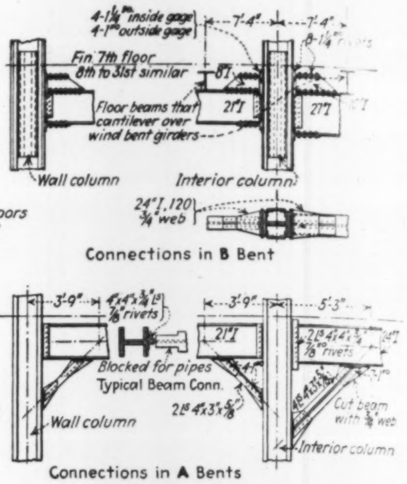
Fig. 5—Complicated cantilever framing at the front corner supports the store fronts and the granite facing. The truss story is devoted to air conditioning equipment.


30" girder beam
Roof
12" I
24" I
2-24" [
24" I
32nd fl.
20'
18" I
24" I
18" I
31st fl.
13'
24 stories at 12'
20'
29'-6"
20'
7th fl.
21" I
24" I
21" I
6th fl.
12'
18" I
24" I
18" I
5th fl.
15'
18" I
24" I
18" I
18" I
8" billet
18" I
4th fl.
15'
7½" billet
Mill gussets
4 Pls 24"x1"
8 Ls 8"x6"x1"
2-2" gussets
3rd fl.
15'
433'
4 Pls 36"x1"
8 Ls 8"x6"x1"
2-2" gussets
Truss
4-15" [s
3rd mezz fl.
16'-9"
Mill
2358
4 Pls 30"x1"
8 Ls 8"x6"x⅞"
4 Pls 18"x⅞"
4 Pls 24"x⅞"
8 Ls 8"x6"x1"
XX Diagonal Sec.
18"
XX Chord Sec.
20½"
3'-3"
Banking Room
2nd fl.
36'-9"
Double truss
4'-9"
Double truss
4'
1st fl.
20'-6"
Girder
Basement
Girder
Girder
Girder
Girder
17'
74
8
7
6
5
68
Sub-basement
16'-9"
19'
21'
21'
21'
19'

Elevation Typical Interior Bent A


Upper floors same
24" I
27" I
24" I
Girder
Girder
Girder
24" I
36" I
24" I
3rd fl.
3rd mezz fl.
2nd fl.
12'-9"
18" I
18" I
24" I
24" I
24" I
24" I
24" I
21" I
21" I
67
1
2
3
4
80

Elevation of Exterior Bent B


4-1¼" inside gage
4-1" outside gage
7'-4"
7'-4"
8-1¼" rivets
Fin. 7th floor
8th to 31st similar
8" I
Floor beams that cantilever over wind bent girders
21" I
27" I
Wall column
Interior column
24" I, 120
¾" web
3'-9"
4"x4"x¾" Ls
⅞" rivets
3'-9"
5'-3"
21" I
2 Ls 4"x4"x¾"
⅞" rivets
24" I
Blocked for pipes
Typical Beam Conn.
2 Ls 4"x3"x⅝"
4 Ls 4"x3"x⅝"
Cut beam with ¾" web
Wall column
Interior column

Connections in B Bent

Connections in A Bents

Wind Bracing

Fig. 7—Wind bents are rigidly braced with double trusses in the lower stories and with kneebraces in all the upper stories. Trusses are of unusual design with all gussets at the column points milled to bear.

as under wind load. Girder sizes and connections were proportioned to permit a maximum deflection of the top of the building of 0.002 times the height, or about 7 in., which is 0.35 in. drift per story. A wind pressure graduated uniformly from 30 lb. at the top of the building to zero at the sidewalk level was used.

Columns

In the service area of the building (the head of the T) columns in general are of rolled sections, with or without coverplates. A typical column for a load of 3,956 kips consists of a 14-in. H 425-lb. section with plates 22x3$\frac{7}{16}$ in. on each flange. In some locations in this area where clearance requirements were severe built-up columns were used, a typical example for a load of 1,771 kips, utilizing a 14x2⅛-in. web plate, four angles 6x4x1 in. and side plates 12x2½ in.

The columns carrying the trusses in the office portion of the building are the most notable. Occupying an area about 3 ft. square, they utilize eight 36x1-in. web plates, eight 8x6x1-in. flange angles and 36x1-in. coverplates (Fig. 3). The loads on these columns averaged about 6,170 kips. In general the columns weigh about 45 tons each, or 1,750 lb. per foot.

Trusses

The trusses in the first, second and third floors occur in pairs, each truss of a pair framing into a web of the large supporting columns. At the points of connection the two center web plates of the column are replaced by a gusset, milled to bear top and bottom on the webs. For the shallow first- and second-floor trusses these gussets are full-truss depth. For the deep third-floor trusses the gusset arrangement is as shown in Fig. 7. In these latter trusses the gussets in the top chord are also milled on their top edges to support the billets that carry these upper-story columns.

The make-up of the members of these third-story trusses is similar to that of the supporting columns—namely, two I-shapes joined by coverplates. The heavy members are built up of plates and angles, while the lighter bracing members of the web system utilize pairs of channels to form the I's. The gussets are inserted between these channels. Each of these heavy double trusses below the third floor required about 115 tons of steel and rivets.

Special details

Because of the facade treatment on two sides of the building in which the columns appear as vertical bands with the window and wall areas depressed, all spandrels are connected on the inside flange of the columns as shown in Fig. 3. The outside flange of the column is thus without the usual bracing, and bent plates are utilized, acting as kneebraces between the outside flange of the columns and the spandrels. Special provision was also necessary to carry the stone facing of the columns, and this was provided by shelf angles on the front and two sides of the columns at each floor level.

The front wall of the building is cantilevered beyond the supporting columns a distance of 6 ft. 5 in., permitting continuous windows along the Market St. front. This is accomplished, as shown in Fig. 3, by extending the floor beams over the girder of the front bent and anchoring them to this girder and to the girder of the next bent in the rear. This arrangement of the cantilevers permitted the girder-to-column connection in the front bent (which are of split-beam type) to be made at the top of the cross-girder instead of at the bottom. Thus a higher ceiling height was permitted, and no encroachment of the connection on the floor above resulted.

Personnel

For the Philadelphia Savings Fund Society Building, Howe & Lescaze, New York City, were the architects, Purdy & Henderson, New York, the structural engineers, and George A. Fuller Co., New York, the general contractor. Steel erection was by Karl Koch Erecting Co., Philadelphia.

◆

Bridge Planned at Baton Rouge

Plans for a combined railroad and highway bridge across the Mississippi River at Baton Rouge have been revived by the Louisiana state highway commission. Construction of such a project was proposed some years ago by the Missouri Pacific System and the Louisiana & Arkansas Railroad.

It is expected that application will be made to the Reconstruction Finance Corp. for funds to construct the bridge. Provision will be made for a lift span.

White Mortar Bands Mark Highway Traffic Lanes

Inlaid strips of white mortar replace painted traffic lines in recent concrete pavements for New Jersey state highways and for various city streets

THE high upkeep cost of painted lines used in marking pavement zones and traffic lanes is leading fast in new construction to the insertion, integrally with the pavement concrete, of white-mortar or concrete inlays. In general, the most common use of this permanent mark construction has been in cities at intersections and plazas and on bridge roadways or main boulevards. The accompanying illustrations show several examples. More recently the practice has extended to the main roads of state systems. New Jersey furnishes a noteworthy example. In recent concrete roadwork in this state not only are the inner traffic lanes marked by inlaid traffic lines but the outer edges of the pavement are similarly delineated, and at special intersections and other places where curbs are installed they are faced with white concrete. Here, as in cities, the motive is to reduce the cost of keeping the marks plain. Frequent renewal is necessary if painted marks are used.

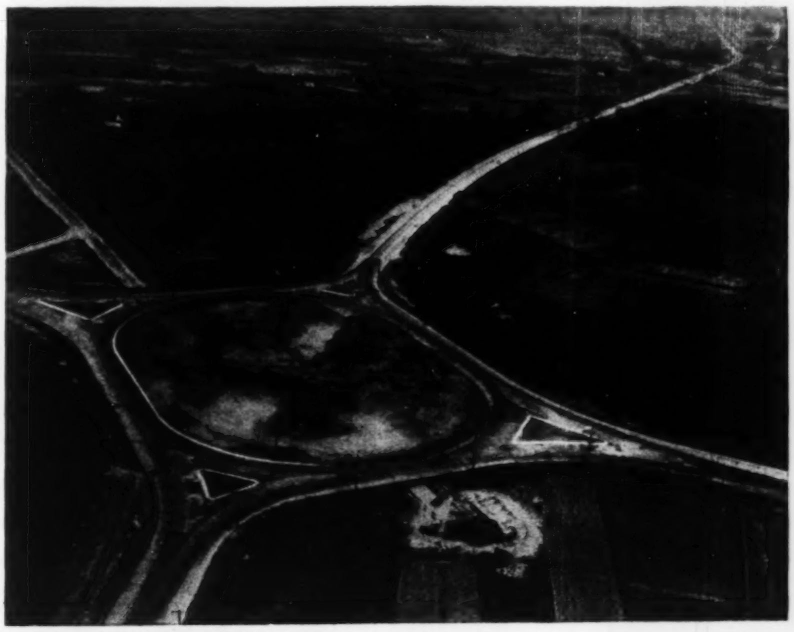
This account of practice covers only the materials and the construction procedures for white concrete inlays and curb surfacing. Location of the marks to serve traffic and convenience best is not considered. The information is of actual practices in New Jersey on state roads and on streets in the various cities named.

New Jersey practice

In New Jersey the practice has been to mark the traffic lanes at curves (vertical and horizontal), at intersections, on three- and four-lane roads and at other points where an orderly array of vehicles is particularly essential to safety and free movement. These lines are painted by a well-organized crew equipped with trucks and line-painting machines. Ordinarily the crew will paint about 5 miles a day. Painting is required from two to three times a year, but on very heavy-traffic roads it may be four or five times. The cost of each painting is upward of 1c. per foot.

In considering white cement inlays in place of painting, experiments were conducted with sands and proportions, thickness of inlay and construction procedure, including curing and cleaning. Cores were bored and strength and bond tests were made. The conclusions were then embodied in a specification for traffic lines and another for curbs. A typical half-section of one of the most recent 1932 operations, showing inlay lane markings, is given in Fig. 2. This is an exceptionally heavy-traffic trunk-line highway, but the lane markings represent standards. Fig. 1 shows the white curb construction on a nearly completed intersection of the circle type.

Fig. 1—Circle intersection on New Jersey state highway, showing the use of white concrete curbs to mark islands and outside of curved roadways.



The materials for the inlay are white cement, white shiny sand and diatomaceous earth. The cement and sand proportions are made the same as for the regular slab concrete, and the diatomaceous earth is added at the rate of 2 lb. per bag of cement. The mixture is inlaid as follows:

After the spading and initial planing of the slab concrete, 5x¾-in. boards, with steel plates on the top 5-in. faces, are embedded in the slab concrete along each form and 1 in. from it. The tops of the boards are leveled flush with the finished surface profile. The final finishing is done over these boards, and immediately afterward, before any setting has occurred, the boards are carefully lifted and the 1-in. shoulder of concrete next to the forms is removed to a depth of ¾ in., particular care in removal being exercised at the expansion joints. The bottom of the 6x¾-in. trench is roughened, and the filling of white concrete is then placed and screeded flush with the finished pavement profile. To insure bond at the bottom, ½- or ⅜-in. rods are thrust down through the white concrete into the slab concrete and then pulled, care being taken not to drag any of the slab concrete to the surface. After a set that will permit firm pressure, a steel float

Fig. 2—Recent roadway section designed for New Jersey trunk highway, showing location and design of traffic-lane marks of inlaid white concrete.

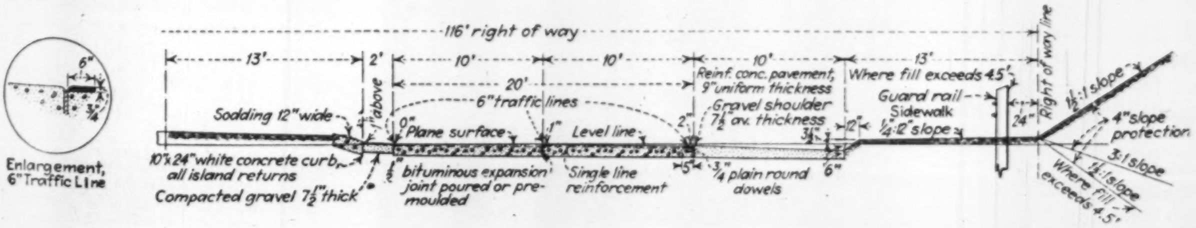

6"
3/4"
Enlargement, 6" Traffic Line
116' right of way
13'
2'
10'
10'
10'
13'
20'
1" above
6" traffic lines
Sodding 12" wide
0"
Plane surface
1"
Level line
2"
Reinf. conc. pavement, 9" uniform thickness
Gravel shoulder 7½" av. thickness
Where fill exceeds 4.5'
Guard rail
Sidewalk
¼":12" slope
3½"
12"
24"
Right of way line
1½:1 slope
4" slope protection
3:1 slope
1½:1 slope
Where fill exceeds 4.5'
10"x24" white concrete curb, all island returns
Compacted gravel 7½" thick
½"
bituminous expansion joint poured or premoulded
Single line reinforcement
5"
¾" plain round dowels
6"

Fig. 3—Standard marking with inlaid white concrete of street intersection in Seattle, Wash. White-faced concrete brick is used to continue white bands across brick paving for street-car tracks.

finish is given to the white inlay. The inlay is then edged as indicated by Fig. 2, and the pavement is ready for curing.

In curing, protection of the white concrete strip from discoloration is essential. Ordinarily the inlay is covered with a non-staining paper of even width held down by 6-in. boards. These remain until curing is completed. Then the inlay is uncovered and scoured clean and white with carborundum stone.

Except that careful work is required, there are no difficulties in the construction of either inlaid traffic lines or white curbs. The materials for curb construction are exactly the same as for traffic lines, and the construction is exactly the same as for ordinary curbs, except that they are constructed in two courses—a base of regular concrete and a white concrete surface course. The traffic lines are giving excellent results and are being bid by contractors at 5c. and 6c. a foot.

City practice

Among cities that have taken up inlaid white concrete traffic lines in an extensive way are Seattle, San Francisco and Los Angeles on the Pacific Coast. These cities have the longest experience, but various Eastern cities are developing practice and making laboratory studies.

At Seattle, Wash., the use of white cement inlays grew out of the previous use of white-faced concrete brick set into the pavement. The use of these was begun as early as 1928 and the wear has been excellent. A white-faced building brick also used in some places has chipped off. The inlay of white cement was undertaken as a more logical method in new concrete pavement construction, and after some trying for the best method a practice was developed.

Examples of Seattle inlaid-pavement marking are shown by Figs. 3 and 4. Fig. 3 is a standard intersection marking, the lines being a white cement inlay except where they cross the brick paving of the car tracks, and here a white-faced brick is used. These are concrete brick 4x8 in. and $2\frac{3}{4}$ in. on the top, which has a $\frac{1}{4}$-in. white facing. The white cement inlay used elsewhere is $5\frac{1}{2}$ in. wide with rounded edges and is $\frac{3}{4}$ in. deep.

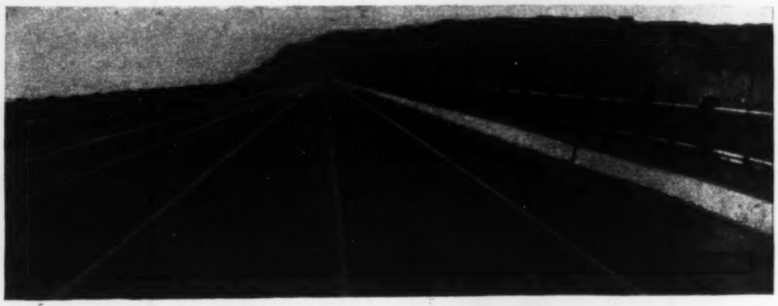


Fig. 4—Inlaid white concrete traffic-lane marks on Aurora bridge, 3,000 ft. long, at Seattle, Wash.

In construction a 1x6-in. board is floated into the slab concrete. Considerable experimenting was done to determine the best time for removing the board. It was found that if the board was pulled before the slab concrete had stiffened, the two colors of grout would mix and injure the sharp delineation of the white mark. In practice, therefore, the time of withdrawal is left to the judgment of the engineer in charge of the work but is specified to be not later than twelve hours after floating. The filling mixture consists of 1 part white cement and $1\frac{1}{2}$ parts of white sand or white marble chips well troweled into the groove and edged.

Inlaid marks at an intersection of Los Angeles streets are shown by Fig. 5. Lane marks for straightaway pavement consist of a 10-in. center strip and 6-in. edge strips. Both consist of 1 part white cement, 2 parts white sand and $2\frac{1}{2}$ parts of crushed stone graded from $\frac{1}{4}$ to 1 in. Recesses for the white concrete are formed by $1\frac{1}{4}$-in. boards 10 and 6 in. wide set flat to profile and supported by stakes notched into their edges 4 ft. apart and driven into the subgrade so as to hold the plank firmly, but also so they will pull out with the board when it is removed. The slab concrete is poured around these forms, finished in the usual way and edged to $\frac{1}{2}$-in. radius at the forms. The forms are pulled as soon as the concrete is firm but never later than two hours

Fig. 5—Inlaid white concrete traffic marks at a street intersection in Los Angeles.

after concreting. The stake holes are filled with cement mortar, and the groove with white concrete is compacted with a wood float and finished with a steel trowel. The white strip is covered with paper, and the seal curing coat is applied to the pavement.

In recent paving in San Francisco black top on concrete base has been marked by casting a raised band or curb of white concrete on top of the base slab. A similar construction has been used in Washington, D. C. In San Francisco the base slab is poured as usual, and then before initial set the raised marker is molded on top, finished with a steel float and edged. A stiff (1½-in. slump) mixture is used, composed of white cement, white sand and crushed rock or gravel in the proportions of six sacks of cement per cubic yard of concrete.

New Incinerators to Burn Washington Rubbish

Engineer-designed plants overcome objections to appearance—Automatic heat control against too high temperatures—Full incineration in furnace cells

INCINERATORS designed to handle the combustible refuse from a population of 620,000 persons and with a total capacity of 595 tons daily have recently been completed in Washington, D. C. Two plants have been provided, one of two furnaces in Georgetown and the other of five furnaces in the southeast section of the city on O St. across the street from the sewage pumping station, near the U. S. Navy Yard and the new Buzzards Point power plant of the Potomac Electric Power Co. Both plants, although in areas zoned for industry, were objected to by near-by property owners. By frank discussion in open meetings all objections were compromised, and by good architectural rendering and landscaping the owners have conceded that the plants have improved the neighborhoods rather than detracted from them. Harrison P. Eddy, Jr., consulting engineer, recently presented a description of the plants to the Boston Society of Engineers, from which the following notes are taken.

The problems of rubbish disposal in Washington have been widely known for a number of years due largely to controversy over incinerator bids. The capacity of salvage and rubbish-burning furnaces having long since been exceeded, burning with its inevitable smoke nuisance was tried before a decision to build incinerators was reached. But in March, 1931, bids were taken on contractors' designs and promptly thrown out by the comptroller general of the United States, who ruled that it was illegal to let a contract on the basis of designs prepared by the bidder. On Dec. 8, 1931, bids were received on plans and specifications prepared by district engineers. The contract, however, could not be let until Feb. 3, 1932, when Congress made funds available.

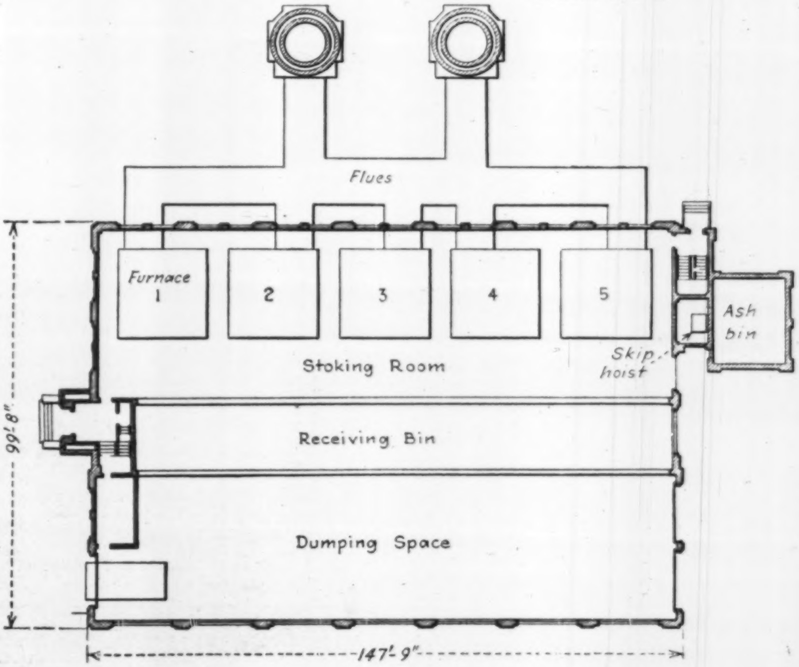
The principal material to be burned is a heterogeneous municipal rubbish containing papers and cartons, wooden boxes, barrels, tin cans, bottles, bedsteads, auto parts and street sweepings. The soil therein is small because of the high percentage of paved streets in the city, so that little trouble from slagging is anticipated. Leaves in the autumn double the volume collected, and following heavy rains they have a moisture content equivalent to that of garbage. In dry weather Washington rubbish has 5.5 per cent moisture and a 5,000 B.t.u. content per pound as collected.

With such a dry, loose and highly combustible fuel, extremely high temperatures will be encountered—in fact, temperatures that would be most damaging to the refractories unless properly controlled. Provision is made for keeping the temperature of combustion within a safely low range by the admission of over-draft air in excess of that required for combustion. Excess-air admission ports are automatically controlled from the pyrometer thermocouples in the combustion chambers. They are shut tight at and below a temperature of 1,400 deg. F. but open wide at 1,600 deg. Alarm bells ring in the stoking aisle and in the office, and a signal light flashes at the furnace in question when the higher temperature is exceeded. No air preheaters have been provided but, to assure that combustion will be completed within the combustion chambers during wet weather, auxiliary oil burners are provided in each furnace.

Collection vehicles enter the O St. dumping floor at one end, pass over a weighing platform, tip their contents into the receiving bin and leave by the other end. The dumping floor is about 6 ft. above street level. Weigh clerks' offices are alongside the platforms at the entrances. Receiving bins have a capacity of 50,000 and 25,000 cu.ft. at the two plants, respectively.

Electric overhead cranes with grab buckets feed fuel to the charging hoppers on the top, or charging, floor. There are two cranes at O St. and one at Georgetown. Each charging hopper spans across and terminates in three charging containers of 1-cu.yd. capacity each. Charges of fuel are dropped through the furnace arches onto the grates below at frequent intervals by manipulation from the stoking floor of

Fig. 1—Stoking floor of the Washington incinerator at O St.



compressed-air-operated gates.

In the furnace proper the rubbish is ignited, gases are distilled off and combustion is started. The furnace chambers are 7.5 ft. deep, 7 to 7.5 ft. high and 18 ft. long, each separated into three cells by division bars projecting a few inches above grate level. Gases flow across all cells, the hot gases from one cell assisting the ignition and combustion in the next cell by the so-called mutual assistance principle. No drying hearths are provided, but there is ample grate area to permit sufficient storage and drying of wet fuel. At the back of the end cell the gases roll over the bridge wall into the combustion chamber where combustion is completed. The volume of the combustion chamber is 2⅓ times that of the furnace proper. From the combustion chamber the gases pass into the flues through checker brick walls intended to ignite any pure carbon which may not have been burned (in the form of charred paper) and to stop the passage of fly ash. The floor of the flues is 3 ft. above the floor of the combustion chamber in order to provide a sump for the collection of dust.

The flues from each furnace are joined by a cross-flue outside the main building, through which the gases pass to the chimneys. At Georgetown there is only one chimney, 9 ft. in inside diameter at the top, 150 ft. high above the grate level and 165 ft. high above the bottom of the foundation, which rests on ledge rock. At O St. there are two chimneys, each 10 ft. in inside diameter at the top and 120 ft. high above grate level, resting upon pile foundations. Each chimney has an independently supported refractory lining for its full height—13½ in. thick at the base, at Georgetown, and 9 in. at O St.

The furnace grates are provided with dumping sections 30 in. long by 15 in. deep, through which the ashes and incombustible residue, such as tin cans and other metal objects, are dumped to the ash pits below. Fires are cleaned twice per shift. Each cell has an independent ash pit with independent control of air for combustion.

Ash pits are lined completely with refractory tile and are provided with continuous quenchers and with airtight, water-sealed, ash-removal gates. The gates are operated by oil pressure. At Georgetown large motor trucks receive ashes directly from the ash pits and haul them to the Foundry Branch dump west of Georgetown University. At O St. ashes are dumped into an electric-motor-operated trolley car, which discharges into a semi-automatic vertical skip hoist at the south end of the ash tunnel. This hoists the ashes into a storage bin of 5,000-cu.ft. effective capacity, from which they are dropped into motor trucks for delivery to the Anacostia Park development for use as fill.

The furnace walls consist of 13½ in. of firebrick, bonded into 12 in. of red brick. On the exterior is a complete casing of steel, 3/16 in. thick. Similar construction is used for the flues inside the building, except that the linings are reduced to 9 in. in thickness. Outside the buildings the outside steel casing of the flues is omitted, and a corrugated asbestos roof is provided. Where flues exceed 10 ft. in height the lower portion of the firebrick lining is 13½ in. thick.

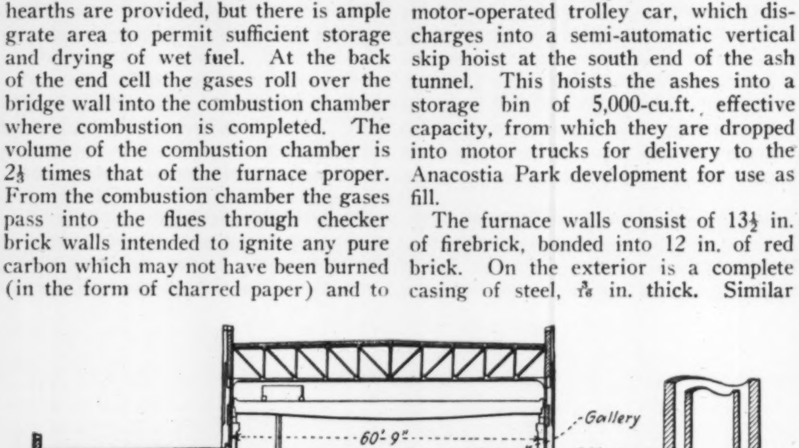


Fig. 2—Section of Georgetown incinerator with 25,000-cu.ft. receiving bin, but otherwise typical of both plants. The combustion chamber is 2 1/3 tmes as large as the furnace proper.

Suspended arches are used over all furnaces, the combustion chambers and the flues for their entire length to the entrance to the chimney. Experience with sprung arches indicates in general that they are not so satisfactory as suspended arches where the temperature changes are so sudden and great and the vibrations from charging equipment are so severe as in these incinerators.

Water-cooled dampers are provided on each furnace flue. These flues are 6 ft. wide by 10 ft. high inside, which makes their weight so great that counterweights and hand winches are provided for damper operation. When the dampers are lowered, water must circulate through them continuously.

The general contractors are the Rust Engineering Co., of Pittsburgh, at O St., and the North-Eastern Construction Co., of New York and Baltimore, at Georgetown. The furnaces at O St. were built by the general contractor, and those at Georgetown by the Standard Arch Co., of Frostburg, Md. Both plants were built under the supervision of J. B. Gordon, director of sanitary engineering, District of Columbia, with A. B. Greene as resident engineer. Metcalf & Eddy were the consulting engineers.

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Wind Interferes With Ventilation of Railway Tunnel

Difficulties as yet unsolved have developed in the operation of the 4.2-km. double-track tunnel at Cochem, Germany, the longest railway tunnel in that country. The situation, as reported recently in the *Frankfurter Zeitung* from information given by Dr. Sarter, the head of the Trier railway district of the Reichsbahn, is largely due to increasing density of traffic.

Opened in 1879, the tunnel was equipped twenty years later with a blower plant at the northeast portal, at the edge of town, which was to blow the smoke out of the southwest portal. However, the prevailing winds being from the southwest the smoke was pocketed in the tunnel. In 1914 a shaft was sunk from the hilltop to the tunnel, about ¾ mile inward from the southwest portal, with exhausters at the head of the shaft to draw out the pocketed smoke. Subsequent experience showed that these exhausters drew chiefly from the short segment of the tunnel, the one adjoining the southwest portal, and so failed to clear the tunnel.

The remedial proposals now under consideration are: (1) installation of a more efficient blower and nozzle equipment, and (2) construction of a second ventilation shaft near the middle of the tunnel. The latter is considered too costly, while the former method, if limited to a tolerable air velocity (12 ft. per second), would not clear the tunnel rapidly enough, as the average train interval is only 10 min.

Roadbed maintenance in this tunnel has been at all times difficult, and it is said that the track ballast has not been completely renewed in the 53 years since the tunnel was built. Complete replacement of ballast and track construction is now in progress, by sectional replacement in two 2½-hour intervals at night between trains, using a large working gang and ample work-train equipment. Track sections 30 m. long are assembled outside, brought into the tunnel by train and are placed by cranes after the old track has been torn out and the ballast completely removed and replaced by fresh stone unloaded from self-dumping cars and rolled. Three track sections are placed in a single train interval. Chair construction is used in the new track because of its greater rust resistance.

High September Floods Along the Rio Grande

By **L. M. Lawson**
Commissioner, International Boundary Commission, El Paso, Tex.

During September heavy rains along the length of the Rio Grande between Presidio and Rio Grande City, a distance of about 680 miles, caused large and small tributaries to contribute unprecedented amounts of run-off, which when accumulated in the main channel aggregated over 3,000,000 acre-feet. Extraordinary precipitation was recorded, principally on the Devils River watershed, one of the smaller tributaries, with a drainage area of only 4,000 sq.mi., and the run-off of that stream exceeded all known records. Flood peaks from the different tributaries passed down the river into the Lower Valley district, overflowing large areas and causing great damage to structures on tributaries and in the main channel.

The Devils River discharge was perhaps the most phenomenal of any of the contributing areas. The drainage area of this 80-mile river produced a run-off of 134 sec.ft. per square mile and a flood height of 48.4 ft., which is 18.2 ft. above any previous known record.

The following table gives gage heights, estimated discharge and locations for the first flood peaks of September, which were followed by several crests of smaller amounts:

A main-line railroad bridge over the Devils River just above its junction with the Rio Grande was destroyed and the canyon section here was almost completely denuded of large trees and soil. A cross-section of a large pecan tree recovered downstream shows an age, by tree-ring method, of about 85 years.

At Del Rio the highway bridge over the Rio Grande was greatly damaged. Intake works of the Maverick County Canal, located below Del Rio on the main Rio Grande, suffered damage estimated at about $200,000.

At Laredo the steel railroad bridge over the Rio Grande was put out of commission by the loss of two spans, and the concrete highway bridge was overtopped. Large areas of farm land at Eagle Pass and Laredo were under water.

It is estimated that 50,000 acres of land on the American side in the lower delta country was overflowed, and on the Mexican side estimates made from airplane surveys show over 150,000 acres overflowed.

Engineering parties put in the field shortly after the passage of flood peaks obtained cross-sections and slopes to permit computation of discharge. The highest of the flood peaks on the Rio Grande as above tabulated was caused primarily by the combined floods of the Pecos and Devils Rivers. At a later date in the month, floods also occurred in the Conchos River on the Mexican side, which discharges into the Rio Grande near Presidio, Texas, and likewise in a number of arroyos below that point. All of these discharges contributed to record breaking run-off in that portion of the Rio Grande below Presidio, Texas.

GAGE HEIGHTS AND ESTIMATED DISCHARGES—LOWER RIO GRANDE FLOOD PEAKS, SEPTEMBER, 1932

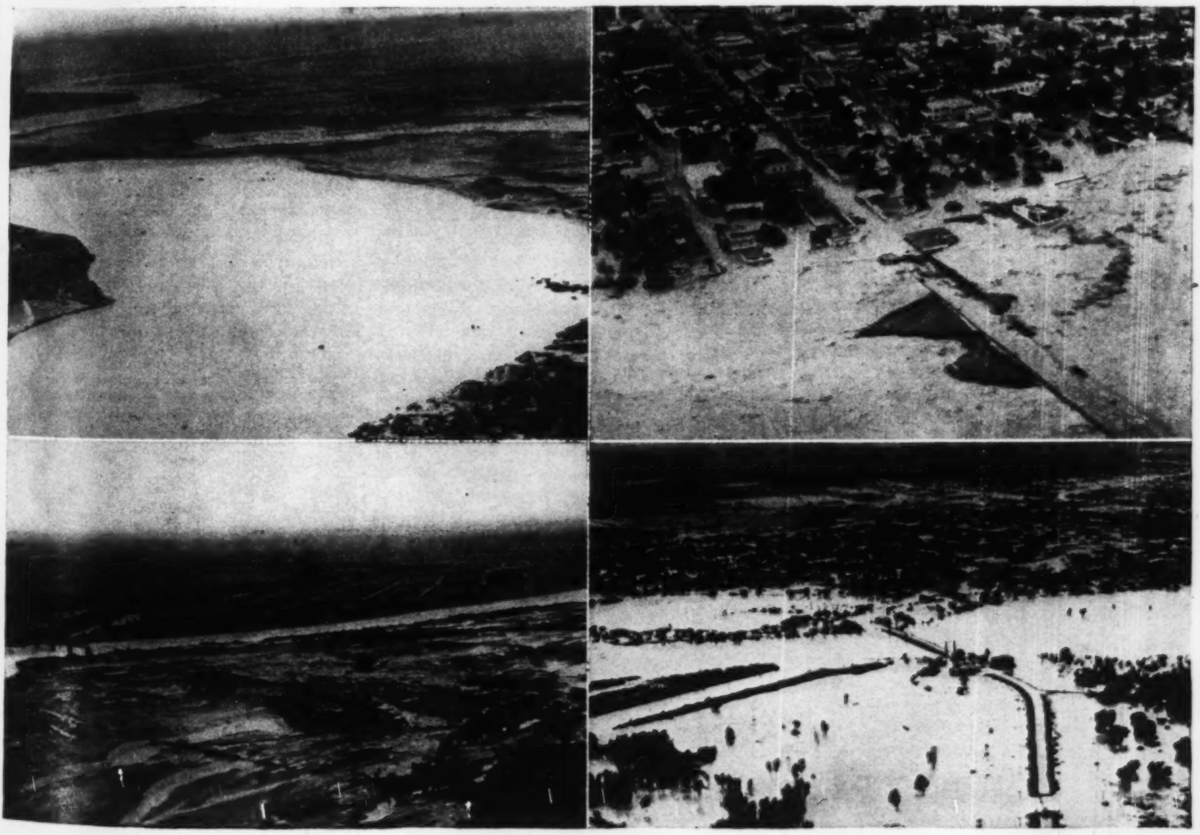
No.	Place	Time	Gage (Ft.)	Est. Disc., (Sec.ft.)
1	Devils River	5:00 p.m. Sept. 1	48.4	537,000
2	Pecos River	3:00 p.m. Sept. 1	34.5	107,000
3	Del Rio	8:30 p.m. Sept. 1	34.5	591,000
4	Eagle Pass	11:00 a.m. Sept. 2	49.0	623,000
5	Zapata	7:00 p.m. Sept. 4	262.1	237,000
6	Roma	11:00 a.m. Sept. 5	35.4	215,000
7	Rio Grande City	8:30 p.m. Sept 5	154.7	183,000

REMARKS —

Nos. 1 and 2 are at gaging station sites above junction with main Rio Grande. Nos. 3 to 7 are near towns of same name.

Estimated discharges are calculated from slopes and cross-sections and current-meter measurements of less than peak discharges.

Gage heights for Nos. 5 and 7 are sea level datum.



Rio Grande floods as seen from the air during Sept. 3 and 4, 1932, high water.

Upper left: Crest of flood 3 miles above Laredo. Upper right: Nuevo Laredo, Mex., partly submerged. Lower left: Del Rio bridge, isolated by approach washout. Just below this point the irrigation canal intake works suffered costly damage. Lower right: Bridge at Reynosa, Mex., just awash, and break in approach road.

Photos by Air Corps, U. S. Army

Hoover Dam Cement Specifications Tentatively Formulated

Reclamation Bureau engineers and consulting boards decide to call for two cements of low and moderate heat evolution respectively—Fineness to be rated by surface area —Briquet replaced by crushing test on concrete cylinders

By John L. Savage
Chief Designing Engineer
Bureau of Reclamation, Denver

IN THE building of any structure outside the realm of past experience and involving unprecedented problems in design and construction it becomes necessary to revise previous practice and institute new methods to attain the maximum in efficiency, economy and progress.

A tentative cement specification for Hoover Dam and appurtenant works is issued at this time principally to provide an opportunity for cement manufacturers interested in bidding to study its provisions, consider manufacturing costs, and express their reactions before the final specification is issued next spring. While minor changes in the tentative specifications are anticipated, it is not expected that there will be any radical departures from the present general setup.

Studies of cement composition

The requirement for speed, a characteristic of all work connected with Hoover Dam, made it necessary to enlist the services of various agencies in investigating certain phases of the field of cement and concrete. The cement research of the Riverside Cement Co. (*ENR*, Oct. 6 and 13, pp. 404 and 435), the results of which were early made available to the government, was of inestimable value in providing a groundwork. The early experiments of the Bureau of Standards and of Burton Lowther, a consultant of the Bureau of Reclamation, and the later investigation of cements by the University of California, under the direction of Prof. R. E. Davis (*ENR*, Oct. 20, 1932, p. 461), paved the way for the selection and adoption of a cement of relatively low heat generation for the mass concrete tests now in progress in the laboratories of the Bureau of Reclamation in Denver.

The substantial cooperation of the California Portland Cement Co., Monolith Portland Cement Co., Riverside Cement Co., Southwestern Portland Cement Co., and the Yosemite Portland Cement Corp., made possible the production of the majority of cements used in the University of California investigation, which investigation provided the principal basic data for the preparation of the tentative cement specifications. These same companies are now producing a limited number of cements of selected composition to be used by the Bureau of Reclamation laboratories in Denver this winter for making comparative concrete tests to determine finally the composition having the most favorable properties for mass concrete for Hoover Dam. The results of these tests will be available for the drafting of the final cement specifications.

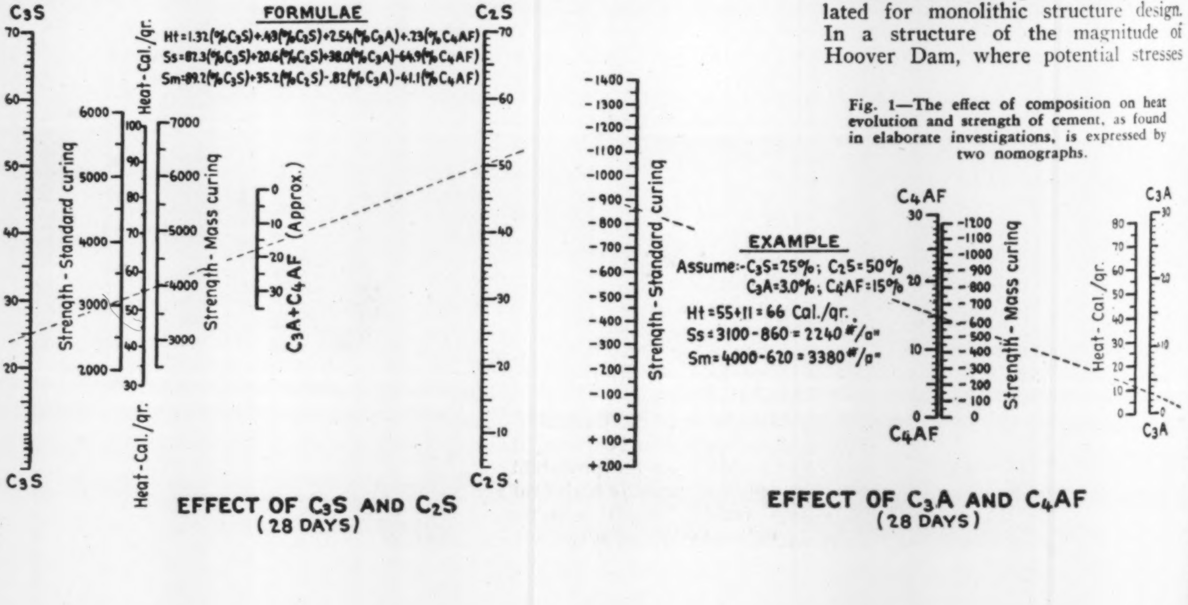
During the progress of the cement investigations conducted by the University of California, conferences with representatives of cement manufacturers were held at Los Angeles and Berkeley, California, for discussion of the research program and test results. Invitations to participate in these conferences were extended to all cement companies having mills in the Southwestern portion of the United States.

Need for new specification

The demand in recent years for rapid concrete construction and repair work has apparently dictated the course of cement development leading to the present high-early-strength cements. Were it not for certain undesirable characteristics of these cements it is probable that the cement for Hoover Dam would be purchased under the standard government specification for portland cement. High early strength in cement, while of acknowledged value in some work, is coupled with other properties which in mass concrete are not conducive to durability and continued strength with age; yet the latter qualities are essential for the fulfillment of the slogan "Concrete for Permanence." Hence, a cement specification designed to control the properties of the cement was deemed necessary for Hoover Dam.

Volume change and cracking

The undesirable characteristics of a cement are manifested in accentuated volume change and cracking in massive hydraulic structures—an objectionable condition not only from the standpoint of appearance due to leakage but also from the standpoint of induced stress distribution differing from that calculated for monolithic structure design. In a structure of the magnitude of Hoover Dam, where potential stresses



EFFECT OF C_3S AND C_2S
(28 DAYS)

EFFECT OF C_3A AND C_4AF
(28 DAYS)

Fig. 1—The effect of composition on heat evolution and strength of cement, as found in elaborate investigations, is expressed by two nomographs.

are necessarily large, the control of volume change—and consequently of contraction joint openings and of cracks—is a factor of prime importance.

In recent years the radial contraction joints of all dams built by the bureau have been grouted as soon as the internal heat in excess of that corresponding to mean annual atmospheric temperature had disappeared. This dissipation of excess heat in relatively thin dams is accomplished in a comparatively short time by natural means. However, in a structure of the dimensions of Hoover Dam the excess heat would, unless artificially removed, still be present in some measure in the thicker portions of the dam after a century or more.

Heat evolution

It is apparent that volume change and visible cracks in mass concrete are generally the outward evidence of inward disturbance, and that internal temperature variation caused by the heat evolved during the hardening process is an important factor contributing to the disturbance. This variation in temperature cannot be eliminated, but it can be modified and controlled. The laws of heat flow have been established for over 100 years, refrigeration has recently become a highly developed art, and grouting of cracks or contraction joints has been practiced with considerable success. On the other hand, the chemistry of the evolution of heat in hardening cement has until very recently received only meager attention. For this reason the bureau decided to launch a comprehensive investigation of portland cements and concrete in an attempt to create in Hoover Dam a structure more durable than any heretofore constructed.

Compound composition

The effects of the principal computed compounds of portland cement on strength and heat generation, as revealed by the results of the recent cement investigation, are shown graphically by the accompanying 28-day nomograph and the chart of unit compound contributions, Figs. 1 and 2. These graphs are part of a series being prepared by the bureau for summarizing and presenting in a form for practical application the important experimental findings. The charted values are tentative and subject to revision with the accumulation of additional test data.

Early studies of low-heat cement

During the early studies of Hoover Dam and prior to issuance of the specifications for its construction, serious consideration was given to the possibility of eliminating all undesirable volume change in the dam by pre-cooling the concrete ingredients and using a low-heat cement. At that time practically no data bearing directly on the subject were available, and the heat-of-hydration values then assumed for concrete of sufficient strength were, in the light of present knowledge, underestimated. On the other hand, the qualities possessed by a relatively low-heat cement of suitable composition are far more attractive than was apparent in the early stages of the investigation.

After the preliminary investigations were well under way a board of concrete experts was appointed to assist the bureau in the formulation of plans for cement and concrete research. The board consists of P. H. Bates, chairman, W. K. Hatt, H. J. Gilkey, Raymond E. Davis, and F. R. McMillan. The Hoover Dam Consulting Board, consisting of Louis C. Hill, D. C. Henny and W. F. Durand, sits in joint session with the Concrete Research Board to consider the important structural phases of the work and their bearing on the research program. The late A. J. Wiley was also a member of the board. In the October meeting the joint board reported on the cement investigations to date and on the draft of tentative specifications presented by the bureau for its consideration. The changes in the specifications suggested by the board are embodied in the abstract of the specifications which follows. The board is of the opinion that these specifications will result in a concrete of greatly improved thermal properties, increased durability and adequate strength as compared with concrete made with present-day cement.

Reasons for considering two cements

Bearing in mind that the interior of a large mass of concrete such as a dam will eventually reach a balance between mean annual atmospheric temperature and the temperature of the water in the reservoir, it is evident that heat evolution of the cement is not necessarily the sole contributor to mass contraction, since the initial temperature of the concrete at time of placing will, during a large portion of the year, exceed both the mean atmospheric and the mean reservoir water temperature. Thus, in summer the high initial temperature of the concrete will be a factor of nearly as much consequence as the heat liberated in the cement, while in winter the low temperature of the freshly mixed concrete will act to offset the effect of heat evolution, possibly even to the extent of reducing mass contraction so that grouting of the contraction joint openings would be impracticable. For Hoover Dam these considerations point to the desirability of using a cement of lowest practicable heat generating qualities for the summer months and a cement of varying heat characteristics for the remainder of the year.

In addition to the possibility of using a higher-heat cement during the winter months there is the probability that a cement of moderately high heat generating qualities with resulting early strength will be required in the construction of thin highly reinforced parts of the work encountered in the spillways, power plant and outlet works.

For the reasons above cited it was decided to give consideration to the use of two cements, and their blending (when desirable) in a plant to be located at Boulder City. This blending plant will permit type A (low-heat) cement to be combined with type B (moderate-heat) cement in the particular proportions desired to meet field conditions, and will also permit the blending of cements of the same type coming from different mills, to eliminate differences in composition, specific surface, color and temperature, and to produce a mixture of cements having essentially uniform workability, setting, hardening, strength and heat characteristics.

The specifications embrace only true portland cement, which is defined as "the product obtained by finely pulverizing clinker produced from an intimate and properly proportioned mixture of materials selected to give the properties hereinafter specified, with no additions subsequent to calcination excepting water and/or uncalcined gypsum."

Two types of cement are specified—one of low heat evolution (type A) and one of moderate heat evolution (type B).

Low-heat or type A cement

Composition—It is provided that the limits on chemical composition shall not exceed the following:

Loss on ignition	3.00 per cent
Insoluble residue	0.50 per cent
Sulphuric anhydride (SO_3)	2.00 per cent
Magnesia (MgO)	4.00 per cent
Uncombined lime (CaO)	1.50 per cent
Ratio of percentage of iron oxide to percentage of aluminum oxide	1.5

The specified limits on theoretical compound composition, when computed according to the method outlined by Bogue (Paper No. 21, Portland Cement Association Fellowship, on "Calculation of the Compounds in Portland Cement") are as follows:

Dicalcium silicate ($2CaO\cdot SiO_2$) Not over 60 per cent
Tricalcium aluminate ($3CaO\cdot Al_2O_3$) Not over 5 per cent

It is contemplated that the final specifications may also impose upper limits on tricalcium silicate ($3CaO\cdot Al_2O_3$) and on tetracalcium aluminoferrite ($4CaO\cdot Al_2O_3\cdot Fe_2O_3$).

Fineness—The specification provision expressing fineness of the cement in terms of specific surface, with a range from 1,300 to 1,700 sq.cm. per gram, is founded on a recognition of the inadequacy of the standard sieve test as a fineness indicator. The specific surface limits stated are based on determinations using the micrometer apparatus of the Riverside Cement Co., and correspond in a general way to commercial Portland cement finenesses of 87 and 97 per cent, respectively, passing the No. 200 mesh sieve. The finenesses are not likely to be changed in the final specifications, although the specified values for specific surface may be altered to express them in terms of measurements by turbidimeter apparatus (mentioned later). The relatively high fineness range for the low-heat cement will improve the strength characteristics at early ages and accelerate the heat evolution.

Soundness—The specifications include the customary standard test for soundness, with the proviso that in the final specifications there may be substituted, for the conventional neat cement pat, a neat cement and/or mortar bar, approximately 1 in. square by 6 in. long, to permit length measurements before and after exposure to the steam.

Time of Set—It is stipulated that initial set shall be developed in not less than 1 hr. 45 min., when the Gillmore needle is used, and that final set shall be attained within 10 hr. The use of the Vicat needle is eliminated.

Strength—The time-honored tensile strength test on 1:3 standard mortar briquets is replaced by a more appropriate compressive strength test on 3-in. by 6-in. concrete cylinders made with Hoover Dam aggregate graded to ¾-in. maximum size. The concrete is to consist of 1 part of cement and 5.2 parts of aggregate by weight, with sufficient water to produce a fixed consistency corresponding to a 3-in. slump in a cone 10½ in. high. The procedure is designed to yield water-cement ratios approximately equivalent to those which would obtain in concrete of proposed full mass mix and field consistency. It is required that the 3x6-in. test cylinders, under standard conditions of curing, develop minimum strengths of 1000 and 2000 lb. per sq.in. at 7 and 28 days respectively, and that the strength at 28 days be at least 50 per cent higher than that at 7 days.

Heat and Temperature—Cumulative heat of hydration, as determined by the heat-of-solution, method, is limited to 60 calories per gram of cement at the age of 7 days and 70 calories at 28 days.

One further provision is that the temperature of the cement at time of delivery shall not exceed 135° F. during the months of May to September inclusive.

Moderate-heat or type B cement

The detail requirements for type B cement are the same as for type A cement, with the following exceptions:

(1) *Composition*—No limit is placed on dicalcium silicate ($2CaO\cdot SiO_2$); the limit on tricalcium aluminate ($3CaO\cdot Al_2O_3$) is 8 per cent; and the tricalcium silicate ($3CaO\cdot SiO_2$) is limited to 60 per cent.

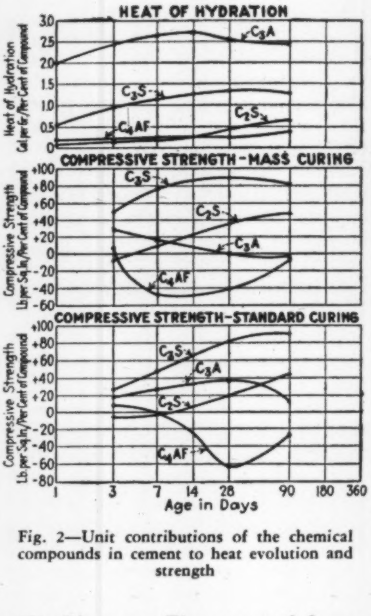


Fig. 2—Unit contributions of the chemical compounds in cement to heat evolution and strength

(2) *Fineness*—The range of fineness is from 1200 to 1600 sq.cm. per gram, corresponding roughly to finenesses of from 85 to 95 per cent passing the No. 200 mesh sieve.

(3) *Strength*—The minimum compressive strengths are 2000 and 3000 lb. per sq.in. at 7 and 28 days respectively, and the strength at 28 days must be higher than at 7 days.

(4) *Heat of Hydration*—The cumulative heat of hydration must be greater than 70 calories per gram at 7 days and less than 100 calories at 28 days.

(5) *Delivery Temperature*—There is no limitation on the temperature of type B cement, since it is not intended that this cement will be used where the minimizing of concrete temperature is a primary objective.

Methods of sampling and testing

Cement samples for test purposes are to be taken at the mill from the conveyor delivering to the bin, unless otherwise specified. It is planned to make tests for specific surface, normal consistency, time of setting and soundness from samples representing each 400 barrels of bulk cement, and to test for chemical and compound composition, heat of hydration and compressive strength from samples representing each 2000 barrels.

The apparatus for measuring specific surface is a recent development of the U. S. Bureau of Standards. It is essentially a turbidimeter in which a light of constant intensity is passed through a suspension of the cement sample into a sensitive photo-electric cell, the current generated in the cell being measured with a microammeter. After certain characteristics of a given brand of cement have been established, the specific surface of a cement sample can be determined in a few minutes, from a single reading of the microammeter. The gradation or size distribution of the cement particles can also be determined, if desired, from a succession of readings taken during the settling of the suspended material.

Heat of hydration is to be obtained by determining the heats of solution, in an acid solvent, of dry cement and partially hydrated cement and subtracting the latter from the former value. The apparatus to be employed is a heat-of-solution calorimeter developed by the research laboratory staff of the Riverside Cement Co. It consists essentially of a calorimeter vessel in which the cement sample is dissolved, and a calorimeter, both maintained at constant temperature. The calorimeter vessel is equipped with an electric heater coil, an electrical resistance thermometer, and a mechanical stirrer for agitating the liquid in the calorimeter as the cement is dissolved. The heat of solution is computed from recorded observations of the time-temperature rise of the liquid (during the period of dissolution) and a knowledge of the calorimeter constants. A period of 30 to 60 minutes is required for a heat-of-solution test.

All designing studies and investigations are under direction of the writer. All engineering and construction work of the bureau is under the general direction of R. F. Walter, chief engineer, of the U. S. Bureau of Reclamation with headquarters at Denver, Colorado; and all activities of the bureau are under the general charge of Elwood Mead, Commissioner of Reclamation, with headquarters at Washington, D. C.

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Reinforcement-Bar Specifications

In the past, most of the specifications for deformed concrete-reinforcement bars have not defined definitely the method of determining the area of the bar. A study has been made at the Bureau of Standards of four methods of area determination now in more or less general use, to find out which method is most suitable. The results showed that the nominal area was most convenient for specification work and should be used if it were considered sufficiently accurate. Further, the weight-length method was more suitable for this use than either the immersion, micrometer or planimeter method. These specifications also have allowed the testing of machined bars in place of the bars with the original deformations. Comparative tests indicate that the differences in the tensile strength were too small to warrant the expense of machining the bars. Research Paper No. 486, published in the October number of the Bureau of Standards' *Journal of Research*, should be consulted for a complete report of this work.

Hand Labor Not Extravagant on Michigan Roads

Methods and cost analysis of twelve million dollar roadwork program of winter of 1931-32 for unemployment relief carried out by Michigan highway department

By C. M. Ziegler
Deputy State Highway Commissioner, Lansing, Mich.

One of the largest unemployment relief programs of the winter of 1931-32 by a state highway department was carried out by the state highway commissioner of Michigan. A total of $12,500,000 was spent between Oct. 1, 1931, and Aug. 1, 1932. The work plan was to do as much work by hand labor as could be managed without materially increasing costs but not to displace equipment where its use was unquestionably essential to meet modern cost standards. The following article is an account of methods and experience. —Editor.

About a year ago, that is about Oct. 1, 1931, the unemployment situation in Michigan was very acute. There was considerable agitation for the highway funds to be used to relieve the condition of suffering incidental to unemployment by distribution of these funds for regular welfare work and not for highway construction. Such disbursement was very strongly opposed by State Highway Commissioner Grover C. Dillman. It was thought that a greater benefit would be derived by the unemployed and by the State of Michigan, as a whole, if these funds could be applied to an emergency highway program, whereby value would be received by the state for money spent and the morale of the unemployed would be maintained. A great number of unemployed and their families would thus be directly benefited, it being estimated by the department that by far the greater portion of the highway dollar would go direcly or indirectly into labor. The United States Bureau of Public Roads had estimated that nearly 90 per cent of the dollar spent on highway work went to labor.

Planning the work

About Oct. 1, 1931, therefore the department began work on this emergency program of construction and maintenance betterment projects on our state trunk line system. Contractors of the state were called in and the department's plans for handling this work were discussed with them. By Nov. 1 considerable of the work was under way. Projects were selected upon which the maximum of work could be in progress during the winter months. These involved grading and drainage structures, grade widening and bridges. Some also involved surfacing. Practically all carried a completion date of not later than July 1, 1932.

A minimum wage scale for common labor was established by the department at 35c. per hour based on skip shifts of labor; that is, either three days on and three days off or one week on and one week off. It was also provided that at least 75 per cent of the contractor's personnel on the project must be secured through local unemployment agencies in the county in which the project was located. Truck loadings on grading work were restricted to a maximum of 2 cu.yd. A combination on some projects of the use of teams in grading, power equipment and hand methods was specified. On projects where hand loading of earth was called for, and in order to keep costs of total quantities within limits of reasonable economy, not more than 10 to 15 per cent of the earth work involved was required to be so handled. Items of work, however, which could be done at practically the same cost with hand methods as with equipment was required to be done by hand. These involved such items as trenches for drainage tile and small culverts, wheeling concrete from mixer for small bridges, etc.

In short, the department's special specifications with regard to the use of labor were somewhat similar to those later adopted by the United States Bureau of Public Roads for operation under the present emergency federal-loan program; although they did not cover as broad a field as those under which the federal-loan program is being carried out.

The maximum number of men in construction and maintenance organizations benefited by this program during any one two-weeks period was about 24,000. This is on a skip-shift basis. As all the projects in this program were not under way at the same time, it is safe to say that at least 30,000 men, therefore an equivalent number of families, received benefit during the period covered by the program. This represented at least 10 per cent of the entire unemployed of the state at the time the program was started. The program also covered projects in every county in the state and in every locality of acute distress.

Comparison of costs

When preparations were first made for the department's emergency employment program, it was with some misgiving as to what effect the special provisions would have on the bids received for this work; that is, if the bids would be within the limits of reasonable and common-sense economy of construction. As soon as the first bids were received, however, it was seen that the special restrictions with regard to this work did not materially affect the unit prices received. In fact some of the early bids for earth work under this program were some of the lowest that the department had received for many years for this type of construction.

A careful analysis has been made of the average costs involved in this program in comparison with those of the years previous. Comparisons have been made with the years 1928, 1929, 1930 and 1931. In the years of 1928, 1929 and 1930 the costs were considerably higher than 1931; therefore I am giving below only the comparison of cost between the emergency program and 1931 costs. These are as follows:

Average cost per mile of 20-ft. concrete pavement—1931	$24,136.00
Emergency program	23,463.00
Average cost of concrete surface per square yard (not including cement)—1931	.92
Emergency program	.85
Average cost per mile of gravel —1931	11,381.00
Emergency program	12,388.00
Average cost per square yard 8 in. two-course gravel surface—1931	.35
Emergency program	.40
Average cost per mile of grading and drainage structures—1931.	10,170.00
Emergency program	11,214.00
Average cost per cubic yard earth excavation—1931	.22
Emergency program	.24

The average prices quoted cover a considerable portion of the emergency winter program as awarded prior to Jan. 1, 1932. Bids received for the latter portion of this winter program during the early spring months showed a slight decrease from those received in the fall of 1931. It must be borne in mind however that the real comparison is between the bids received on the winter program work between Oct. 1 and Dec. 31, 1931, and quite an amount of regular work under regular specifications on which bids were received during the latter part of August, September and the early part of October, 1931. There was very little variation between prices when compared as above.

The winter work was also let on the basis of a minimum common labor rate of 35c. per hour, while work let just prior to the inception of the winter program did not carry any minimum rate and rates as low as 25c. per hour were paid by some contractors in certain localities.

In Michigan there took place between about Jan. 1 and Aug. 1 a general slight reduction in material and other prices, and this drop figured somewhat in the general lowering of bids received from the contractors. They were bidding in exceptionally strong competition in order to get business to carry their organizations through the balance of the season.

Sufficient projects were not put under

contract in the spring and summer periods of 1932 more clearly to define average prices during these periods. In the 1932 spring group the earth excavation price had dropped to 20c. per cubic yard, 7-in. center 9 in. edge concrete to $1.18 per square yard (part of this drop due to drop in price of cement) and the average price per mile of 20 ft. concrete pavement had dropped to $22,500.

On a small number of jobs awarded in July and early August the average earth work price dropped still further to 18c., concrete pavement, 7-in. center 9-in. edge, to $1.10 per square yard, and 20 ft. concrete pavement per mile to $19,900.

On the early portion of the emergency federal loan problem, prices came up somewhat to an average of 20c. per cubic yard for earth work, $1.24 per square yard for 7-in. center 9-in. edge concrete pavement and $21,617 per mile for 20 ft. concrete pavement.

As mentioned above I believe however that the true comparison of prices of our winter program were those between the period of Oct. 1 to Dec. 31, 1931, and about Aug. 15 to Oct. 15, 1931 (regular specifications). Had the entire winter program been averaged, including the 1932 spring prices with the 1931 fall prices, the average prices for comparison with regular 1931 prices would have been still more favorable to the winter program, as some of the winter program work had the advantage of the lower spring prices.

Discussion of Economy

From the above comparison of average costs involving millions of dollars worth of construction both in 1931 and under the emergency program and notwithstanding that a great deal of the grading and drainage structure work and gravel surfacing was done under a stiff program schedule and under unfavorable weather conditions, the costs of this emergency program were considered within the limits of reasonable economy.

While the major portion of this program was awarded by contract, certain betterment projects were executed by county and state maintenance organizations under the same provisions as the contract work. In some cases this was done to avoid the necessity of delay, due to preliminary survey, plans and estimates before starting the work. These projects were variable in size and were located in practically every section of the state; thus contributing materially to the relief of the unemployed and affording a great help to the local welfare organizations and funds.

A total of approximately $12,500,000 was involved and expended under this emergency program, the effects of which were distributed over the approximate period of Nov. 1, 1931, to Aug. 1, 1932. The department feels that such a program was a success, did not involve any material waste of highway funds and was a distinct help in the crises of the state unemployment situation during the past year.

Throughout the preliminary preparations for the program and the operations under the program, the department kept in mind that its money must be spent in a business-like way without undue increase in cost of the work and to the maximum benefit of the state of Michigan. Michigan did not displace equipment with hand labor methods. The use of equipment was possibly curtailed, but without undue increase in cost. On some grading projects as many as three or four or more power-shovel units were stipulated and required of the contractor in the operation of his project. Other standard grading equipment was necessarily used by contractors on the department's work under this program and under the special provisions thereof.

Pipe Laid Across Panama Canal By Use of Cable Support

Overhead steel cable serves in place of cradle to support pipe while joints were made up at barge—Canal traffic uninterrupted

By A. L. Hertz
Junior Engineer, Panama Canal

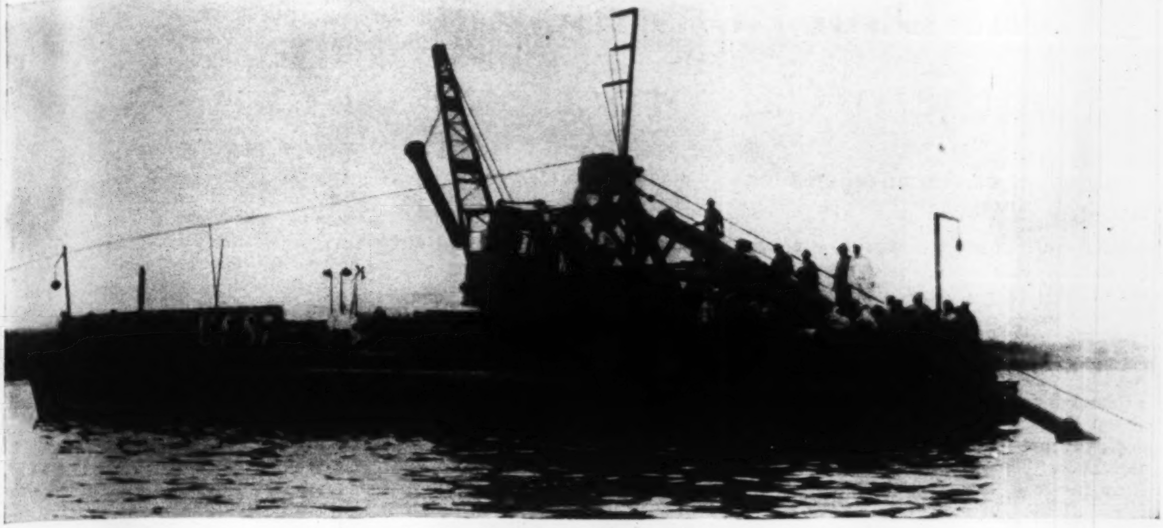
When it became necessary recently to extend the water system of Balboa, Canal Zone, across the Pacific entrance of the Panama Canal, the installation was completed without obstructing traffic by suspending the pipe lengths from a steel cable as the joints were made up and lowering the line to the bottom when necessary. The line was of 12-in. cast-iron with metropolitan-type flexible joints, permitting a deflection of about 13 degrees.

At the location decided upon, there were numerous difficulties which excluded any previously used method of laying submarine pipe lines. The canal channel at this point, is 800 ft. wide, and dredged to El. —50, mean sea level datum. A trench across the canal was dredged to El. —60 and sloped from the canal prism lines to El. 0 on each side; a distance of about 1,500 ft. A tidal range of about 18 ft. made the use of a cradle seem impraticable because of the difficulty in keeping the lower end of the cradle tangent to the bottom of the trench in such rapidly changing depth of water. Lowering from pontoons could not safely be done, because of the swift tidal current. Lowering in sections, and connecting under water by a diver could have been done, but would have been expensive. Any other method that would have closed the canal to shipping for any length of time was, of course, ineligible. It was finally decided to suspend the pipe from a cable as each length was connected so that the pipe line could be lowered to the channel bottom at any time that traffic claimed the right-of-way.

A 1-in., 6x19, plow-steel cable, connected to a dead-man on the west shore and a 25-ton steam hoist on the east shore, was passed over an idler sheave on an A-frame tower 17 ft. high which was mounted on a 30 x 80-ft. barge. An inclined trestle was then constructed on the barge, extending from near the top of the A-frame to the stern, a horizontal distance of 30 ft., upon which workmen poured and caulked the joints. Anchors were placed in four directions and connected by $\frac{5}{8}$-in. cable to hand winches mounted on each corner of the barge so that the barge could be held accurately in line and moved forward about 500 ft. without changing anchors. A fifth hand winch was mounted on the center of the stern, having a cable hooked to the end of the string of pipe as a safety measure when moving the barge. As soon as a joint was poured and caulked it was deflected sufficiently to break the adhesion between the iron and lead and then hung from the main cable by $\frac{3}{8}$-in. cable slings.

The first position of the barge was about 150 ft. from the proposed west end of the line. Shackles were used over the main cable for the first 13 lengths of pipe, and the pipe was allowed to slide down the cable, away from the barge, as each joint was completed. After the first 13 lengths had been suspended, the barge was moved forward each time a joint was completed. It was found that the forward thrust of the pipe was sufficient to move the barge, so that only enough tension was kept on the forward anchor lines to hold the barge over the trench.

The tension in the main cable was adjusted so that a joint rose slightly as it left the end of the trestle. Theoretically, this should have given a maximum deflection in the suspended pipe of less than 2 degrees per 12-ft. length. It was found that carelessness in adjusting the slings sometimes caused a



During construction the pipe lengths were suspended from a steel cable that crossed the canal and passed over a sheave on the barge tower. A cradle could not be used because of the tidal range of 18 ft.

deflection greater than this, but at no time was the maximum safe angle approached.

Because of the necessity of keeping the canal open to traffic through the day, most of the work was done at night. Range lights placed on each shore at the center line of the trench were used for keeping the barge on line.

In the morning, before traffic was resumed through the canal, a bulkhead was placed over the end of the pipe and the barge moved forward, holding the full tension in the main cable until all of the pipe connected was lying on the bottom of the trench. The tension was then released until the cable ahead of the barge was hanging at least low enough in the water to clear the maximum-draft ship.

When work was resumed on the following night the operation was reversed. The tension was taken up in the cable, and the barge moved backward until the end pipe was again raised on to the trestle.

A truck crane on the barge picked the pipe up from the supply in the forward end of the barge and hoisted it to the trestle. Lead was melted over two blacksmith's forges and caulking was done with pneumatic hammers.

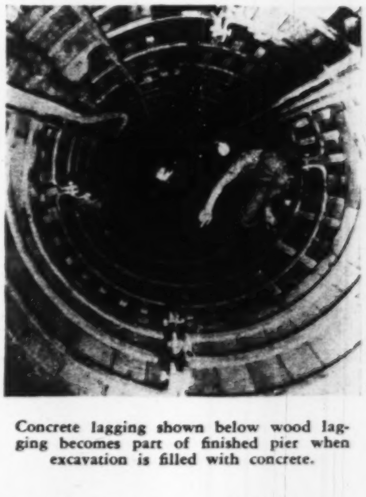
A total of 127 lengths of pipe were laid in 35 hours; a maximum laying speed of eight 12-ft. lengths an hour was attained, but the average was about five joints per hour. This includes time required for changing anchors, but does not include time for raising and lowering the pipe to clear shipping. This last required a total of only 8 hours for the entire job. Upon completion, the line was tested with compressed air, and a few small leaks were easily caulked by a diver. The work was done by the Municipal Engineering Division of the Panama Canal.

Concrete Lagging Used for Deep-Well Caissons

PRE-CAST concrete lagging instead of the ordinary wood lagging was used in one of the caissons in the foundations for the columns of the Field Building now under construction in Chicago at La Salle and Adams Sts. The cross-section of the lagging is T-shaped with the stem placed inward and the flanges or top of the T to the outside against the clay. Thus the metal rings bear against the stems. The edges of the flanges are tongue-and-grooved so that they interlock. The stems are beveled, with the thinnest part near the flange, to dovetail into the later-placed concrete of the pier and make an integral whole of poured concrete and lagging.

Savings claimed by S. G. Martin, a civil engineer formerly with Universal-Atlas Cement Company, who invented the lagging, are in less excavation and less concrete since the piers can be reduced in diameter by double the thickness of the wood lagging, which, though usually left in place cannot be counted on for bearing value. In a 100-ft. caisson 6 ft. in diameter excavation is 15 cu.yd. less and concrete 12.2 cu.yd. less. There are fewer pieces by 75 to handle and 92 ft. less metal ring.

In the 4-ft. lagging used in the Field Building caisson the ordinary 3x6 in. wood pieces weigh about 15 lb. each, whereas the concrete lagging members weighed about twice as much. They were made with haydite aggregate, giving a 100-lb. concrete. The relative cross-section area was 13.3 sq.in. for the finished wood and 11.6 sq.in. for the concrete. In this case the flange was 1½ in. thick and 5½ in. wide, the stem 2 in. long and 2 in. wide at the inside, tapering to 1½ at the flange connection. Reinforcing consisted of welded fabric in the flange and a ⅜ in. bar in the stem bent up at the end of the lagging. The lagging pieces were vibrated in a wood form laid flat with the stem down. Men ordinarily handle two of the concrete pieces and three of the wood pieces.



Concrete lagging shown below wood lagging becomes part of finished pier when excavation is filled with concrete.

Graham, Anderson, Probst & White are the architects, the George A. Fuller Co. is the general contractor and the W. J. Newman Co. is the sub-contractor on caissons and foundation.

Current Dam Construction in Southern California

Distinct types of design represented on each of four structures—1,500 men employed and $18,000,000 of construction involved—Projects will regulate water for municipal use and flood control

By J. I. Ballard
Pacific Coast Editor
Engineering News-Record, San Francisco

IN ANSWER to the ever increasing demand for water control and regulation in southern California, four major dams are now under construction in that area. Three of these structures are to increase the municipal water supplies of the cities of Los Angeles, Pasadena and San Diego, and the fourth is a flood control dam being built by the Los Angeles County Flood Control District. Total storage capacity of the four reservoirs will be 208,000 acre ft. and the projects involve an expenditure of about $18,000,000. The jobs are employing about 1,500 men and in each case unemployment relief within the political unit has been made a factor in the selection of crews. The following outlines the work on the four dams as seen on a recent inspection trip, leaving more detailed technical material for subsequent treatment.

Bouquet Canyon Dam

A 50-mile drive north from Los Angeles into the steep and narrow Bouquet Canyon reaches the site of the rolled-earth dam which the department of water and power is building for a storage and balancing reservoir, essential to the proper operation of the Los Angeles aqueduct since the loss of the St. Francis reservoir storage. The work is being done by the forces of the department, and the 400-man camp is located in the reservoir site just behind the dam. About 65 men out of this crew are engaged in brushing out the reservoir site and are rotated every two weeks as an unemployment relief measure. The rest of the crew is permanent.

Operations as viewed at the present time are typical of rolled-earth construction. About 450,000 cu.yd. have been stripped from the streambed and the sides of the site, the concrete cutoff wall at the upstream toe has been about completed in the streambed and 370,000 cu.yd. of fill have been placed out of the 2,800,000 cu.yd. required in the structure. The dam will be 215 ft. high above streambed and will be faced upstream with a reinforced concrete slab. Both slopes will be 3:1.

Power shovels are at work on both side hills stripping overburden which is trucked into the downstream pervious section of the dam. This earth is then sprinkled and rolled in layers averaging 9 in. thick. From upstream a steady line of trucks comes rolling into the site carrying 7½-yd. loads of earth from the borrow pit for the impervious section. This earth is dumped, spread by bulldozer and rolled in 6-in. layers. The material is of excellent quality, compacting without difficulty and after rolling weighs about 138 lb. per cu.ft.

Up at the borrow pit, about a mile from the dam in the reservoir site, a 2-yd. electric shovel is loading from an extensive deposit of material classified as well-disintegrated granite. The borrow pit area is sprinkled for several days in advance of loading which provides for easier handling, better moisture control on the dam and less dust for men and machines.

The catchment area behind the dam is small and will not be used in its operation. A tunnel is being driven under one abutment to provide for diversion during the two construction seasons. On completion of the dam the upper end of the tunnel will be plugged and a shaft spillway will handle the small local runoff.

Bouquet Canyon—Looking across site upstream, showing impervious section, stripping on side hill and camp in reservoir site in background

Bouquet Canyon—Rolling impervious material in upstream section, with two lifts of stripping operations in background.

The reservoir will be filled and discharged through a 4-mile pipe line which will tap the aqueduct near the head of the San Francisquito No. 1 penstock and terminate in a control tower in the reservoir. Thus, this 34,000 acre ft. of off-the-aqueduct storage will be available as a balancer for power operations and a reserve for the Los Angeles water supply.

The project required about 4 miles of

Pine Canyon—Two 4-yd. buckets of concrete arrive at the same time via the two cableways. Note the distinct slope toward the upstream face.

county road relocation. An agreement has been reached on this feature and the work will be started at once by the department. The road change has been interfering with progress on the work as the old road extended through the lower level of the damsite. Work will involve about 300,000 cu.yd. of excavation, mostly rock.

The entire project is under the general direction of H. A. Van Norman, general manager and chief engineer, department of water and power of the city of Los Angeles.

Pine Canyon Dam

The winding road up the San Gabriel River canyon back of Pasadena leads to two active dam projects in addition to permitting a look at the site for the big San Gabriel dam No. 1 and glimpses of a $1,500,000 highway relocation job now underway as a direct result of the dam construction. For two miles above the town of Azusa the old San Gabriel dam railroad, which was built several years ago to the Forks site, later abandoned, has been rehabilitated. It is being used by the contractor on the Pine Canyon dam to transport aggregate from a commercial plant to a transfer station where it is loaded on an aerial tram for the remaining two-mile trip to the mixing plant at the site.

Beyond the transfer station the old road continues on the right hand side of the canyon, while across the canyon higher up on the steep rocky wall can be seen the grading operations of the Guy F. Atkinson Co. on the new highway contract. This road change is being made as a result of a five-party agreement, with Pasadena and the flood control district each bearing 40 per cent of the cost on account of the dams; the remainder is split by the county, state and federal governments. The work is under the supervision of the U.S. Bureau of Public Roads.

Nearing the site the road passes the camp buildings of the city and the contractor. The camp is very small as most of the crew of about 300 drive to and from work. By agreement these men were recruited from Pasadena unemployed and the usual problems have been encountered in breaking in a crew from this class of raw material. The result has been hard on the contractor and the supervising force but this difficulty is being overcome.

Cement is arriving in bulk by truck and trailer in loads aggregating 21 tons. The cement goes first into a 4,000-ton silo beside the road and from there is conveyed pneumatically through a 4-in. pipe a distance of 800 ft. up a 300-ft. lift to the mixing plant across the canyon. This is the special low-heat cement prepared under the specifications outlined in *Engineering News-Record*, Oct. 6, 1932, p. 410.

The damsite is a little farther on and concreting operations are underway three shifts a day "in the hole" at present. About 30,000 cu.yd. have been placed to date out of the 436,000 cu.yd. in the dam. In addition there will be extensive sections of concrete paving to be placed on the spillway. Over head, two cableways of 1,000-ft. span are delivering 4-yd. buckets of concrete into the dam. These cableways have a common head tower but have separate movable tail towers. They operate as separate units, each taking the output of a 4-yd. mixer located in the plant high up on the left-hand abutment. The buckets come down and are tripped with marked regularity, and after the bottom lifts of concrete have been completed the program will call for placing 2,000 cu.yd. per three shifts.

The concrete is very stiff, even as viewed from the road, and falls from the bucket in a mass without any flowing. On the job it is learned that the material has practically no-slump and a w/c of 0.87. No attempt is made to shovel the concrete but electric, surface vibrators are used extensively in consolidating the mass. Five-foot lifts are being placed and they are maintained on a 10 per cent slope up from the upstream face; no horizontal keyways are provided between lifts. The dam will be 245 ft. high above foundation.

The concrete plant has the usual provisions for storage of aggregates and cement. All aggregate is weighed and special care is taken to check the moisture content of the sand which is of special importance in maintaining the uniformity of such a dry mix. Discharge from each of the mixers goes by short belt conveyor to the loading point of the cableway buckets. Here a shuttle train of two flat cars transfers the empty and loaded buckets. Each cableway op-

Pine Canyon—Vibrating no-slump concrete in place as dropped from bucket. Internal vibrator used near forms. Note men do not sink into fresh concrete.

erates with two buckets, one loading while the other is being lowered into the dam.

Present streamflow is small and is handled by a bypass flume. Provision for floodflow will be made by leaving a tunnel through the dam.

The project is being built by the Pasadena water department, S. B. Morris, chief engineer and general manager. The contract is held by a contracting group consisting of Bent Bros., Inc. Winston Bros. Co. and W. C. Crowell, with Stanley Bent as general manager.

San Gabriel No. 2 Dam

On up the canyon the road leads past the site for the gigantic rockfill dam, San Gabriel No. 1, to be started soon by the Los Angeles Flood Control District. This structure will be 360 ft. high and contain 5,000,000 cu.yd. of rockfill.

Above this location the road continues past the abandoned site of the flood control dam at the forks of the river and swings up the west fork about 10 miles to the work on the district's No. 2 dam. This is a typical rockfill structure with a body of loose rock and a handplaced upstream layer to be faced with a poured concrete and gunite slab. The site was stripped by hydraulic operations as described in *Engineering News-Record*, Sept. 15, 1932, p. 311. The work is well started with about 10 per cent of the 1,000,000 cu.yd. of rock already in place. The concrete cutoff along the upstream toe is completed and the placed-rock section is started. The dam will be 255 ft. high above streambed.

The contractors' camp of about 400 men overlooks the site which occupies an extremely narrow gorge. Diversion of floods during construction will be by 15-ft. diameter tunnel, which was driven under separate contract; lining is underway. After the dam is completed the tunnel will be equipped with valves and used for regulation. The 14,000-acre ft. reservoir will be operated strictly as retention storage for flood control. A spillway for possible floods not handled by the outlet has been cut through one of the abutments and will be concrete lined.

San Gabriel No. 2—Looking upstream into site with spillway cut on left. White rock on right is stripped abutment, and two 25-ft. lifts of dumped rock are underway.

At present the truck fleet is dumping rock on the second 25-ft. lift. The rock is obtained from the quarry 2 miles up the reservoir site. A high face of good granite has been opened up and loading is under way with a 5-yd. electric and a 2¼-yd. power shovel. The quarry output is divided into three classifications: (1) rock going directly into the dam, (2) rock to be put over a grizzly before going into the dam and (3) waste.

Specifications require the rock in the main body of the dam to be "a well-graded mixture of sound, angular, quarry-run rock." Forty per cent is to vary from chips to 1,000-lb. size, 30 per cent to weigh from 1,000 to 3,000 lb. and 30 per cent from 3,000 to 14,000 lb.

E. C. Eaton is chief engineer for the flood control district. The contract is held by a combination of two Los Angeles firms under the name Macco-Lewis Inc.

El Capitan Dam

About 35 miles back of San Diego on the river by the same name the city is building the El Capitan dam to augment the municipal water supply. The structure will be mainly hydraulic fill, but will have rock embankments on both faces and arched concrete toe dams to resist any spreading action of the fill. Its height will be 240 ft. above foundation and the capacity of the reservoir will be 118,000 acre ft. As the dam nears completion a conduit will be constructed to connect with the existing water supply system.

The site is reached by a good road from San Diego. On a level area below the site is the contractor's camp of about 400 men. The camp in layout and buildings is typical of modern practice, and a trial proves the boarding conditions excellent. At present, work is under way in the cutoff trench, the

San Gabriel No. 2—Thirty-ton rock arrives from quarry located two miles upstream. Thirty per cent of fill must consist of rocks weighing more than 3,000 lb.

El Capitan—Looking downstream across site with aggregate stockpiles at right and diversion tunnel portal near left abutment.

diversion tunnel and the quarry for the rockfill. The two arched concrete toe dams 45 ft. high have been completed and rock is being dumped behind the one upstream.

Stream diversion, except low flow which is being carried in a pipe, will be taken care of during the two construction seasons by a 1,200-ft. tunnel 25 ft. in diameter. The pioneer bore for this tunnel has been completed and a length of 350 ft. has been enlarged. Following construction the tunnel will be plugged at the upper end and four pipes through the plug will connect with an outlet tower in the reservoir. The spillway will be of side-channel type located in a depression behind the north abutment.

The site was stripped of loose river deposit and then the section up- and downstream from the central corewall was excavated well into the disintegrated granite of the site. The bottom of the corewall trench is 52 ft. below streambed and a 6-ft. concrete wall will be brought up to streambed elevation. From this level the wall will narrow to 18 in. and will continue up about 35 ft. into the earthfill.

A quarry has been opened up about a mile from the site and well drill rigs are being used to put down vertical holes for loosening the rock. More than 1,000 ft. of face has been opened up and about 1,000 cu.yd. of rock per shift is moving by truck into the dam. The loads of rock average 5.1 cu.yd. and about 1,000,000 cu.yd. will be required.

A central rolled-fill section near the corewall containing 120,000 cu.yd. will be put in first before the hydraulic fill is started. Material for the hydraulic fill will be trucked from borrow pit in the reservoir site and placed by water to form the usual puddle corewall and the beaches of coarser material. The embankments of rockfill will be carried up as the hydraulic fill progresses to provide backing of heavy weight on both sides. Hydraulic fill material required will aggregate 1,350,000 cu.yd.

An extensive system of drains is being provided upstream from the downstream concrete toe wall. Three concrete culverts extend half way to the center line and are provided with holes along both sides. These drains will act to remove the water from the hydraulic operations to the downstream side of the toe wall.

The dam is being built by the water development department of San Diego; H. N. Savage is engineer in charge. The contract is held jointly by H. W. Rohl Co. and T. E. Connolly.

Building Cycles Charted From 1875 to 1932

During 58 years period charts based on the 1913 dollar show gradual decline in activity and wide divergence from general business movements

A SUB-REPORT of the committee on business reports, statistics and trade information to the National Construction Conference in Washington on Oct. 13 and 14 presented a significant study of building cycles in the United States. This study was submitted by John R. Riggleman of the division of building and housing of the Department of Commerce and covered the available records since 1875. It was presented as a preliminary statement to be revised as further information developed.—EDITOR.

THIS REPORT presents a preliminary index of building cycles in the United States from 1875 to 1932 as far as they may be indicated by building permits per capita in terms of the 1913 dollar for 52 cities since 1900 and a varying number before that date. The index is confined to building only and does not represent other types of construction.

Building permits per capita in 1913 indicate (though not conclusively) that the long-time trend of the volume of building per person has declined approximately 12½ per cent since 1875.

The most noteworthy indications of the building-cycle index in this report are: (1) that building cycles last several times as long as the usual business cycles; (2) that building cycles deviate several times as far from normal as business cycles; and (3) that while a change in business is quite often preceded by a corresponding movement in building, sometimes business precedes building, and sometimes the two move in opposite directions.

The index presented is preliminary, and the interpretations are qualified in accordance with the limitations of building-permit data.

Reliability of index

Building-permit figures ordinarily furnish one of the best available indicators of the changes in building activity throughout the country, and the only continuing indicator of activity over a long period of time. They are however, subject to many limitations. In spite of the limitations, however, it is quite probable that there are but few industries that have a better index of

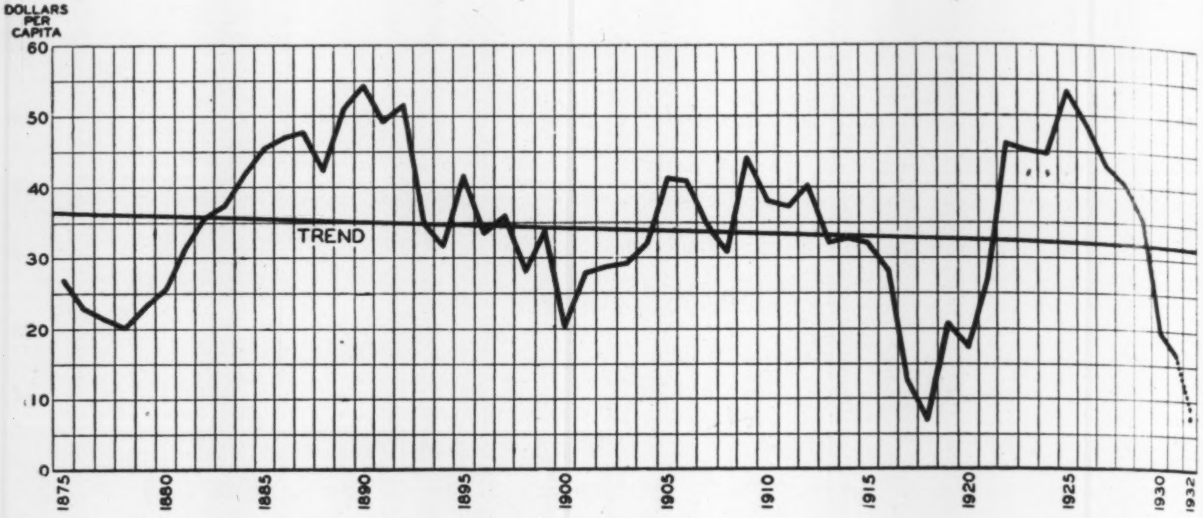


Fig. 1—Building permits per capita in terms of the 1913 dollar indicate a slightly downward trend for the period 1875 to 1932.

activity over a long period of time than the building industry has in building permits.

To simplify the problem of trend determination and of using a varying number of cities prior to 1900, the permit values were placed on a per-capita basis. The population was estimated as of July 1 of each year on the basis of a smoothed logarithmic curve drawn through the population figures for the different decennial census dates.

Since the building-permit figures used were stated in terms of value, the data were converted to their equivalents in 1913 dollars in order that the fluctuations in the volume of building activity might not be confused due to changes in price conditions, especially during the World War inflation period. For this purpose a specially devised index of building costs was used for the period from 1875 to 1903 inclusive, based upon the *American Appraisal Index* numbers of cost of industrial buildings in Eastern cities. Indexes for frame-building costs and for brickmill costs were used throughout the period, and to these were added indexes of frame iron-clad buildings and of steel iron-clad buildings in 1890, and indexes of reinforced-concrete construction and of concrete and steel construction costs in 1900.

Per-capita curve

Building permits per capita in terms of the 1913 dollar are shown by the curve in Fig. 1, and a long-time trend line (computed by the method of semi-averages) is also shown on this chart.

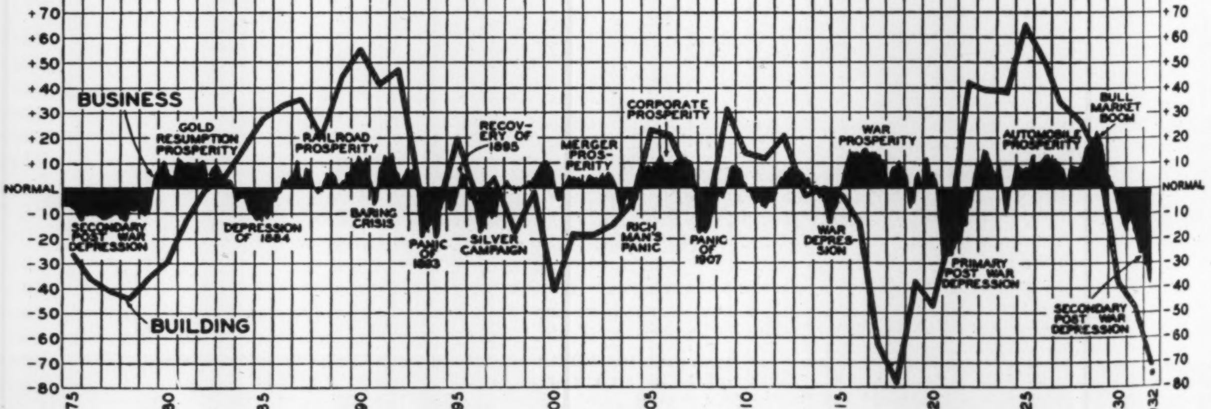
It will be noted that the trend decreased from about $36.20 per capita in 1875 to about $31.66 per capita in 1932, which is a decrease of about $4.54 per capita for the period, or 8c. per year. This decline is undoubtedly due to the decreasing rate of growth in the group of cities. Too much significance, however, should not be attached to the slope of this trend line, as it is probable that an extension of the period either backward or forward will cause some change in slope.

Percentage curve

When the building-cycle curve is stated in terms of percentage deviation from the normal trend, it appears as shown in Fig. 2. From 1875 to 1932 it shows three major cycles. In these major cycles there are many smaller cycles. The three great swings since 1875, however, indicate quite clearly three great waves or major cycles in building activity. The smaller cyclical movements within the major cycles have their movements accelerated or retarded according to whether or not the directions of the movements in the major cycle correspond.

The length of the cycles from one depression period to the next is about a business generation. The first one shown by the curve covers the 22-year period from 1878 to 1900 (12 years upswing and 10 years downswing); the second covers the 20-year period from 1900 to 1918 (9 years upswing and 9 years downswing); and the third, so

Fig. 2—Cycles of building activity as indicated by building permits per capita reduced to terms of the 1913 dollar and expressed in percentage deviations from normal trend.



far, has covered 14 years from 1918 to 1932 (7 years upswing and 7 years downswing). Decreasing lengths of these cycles over the period are not believed to be significant due to the tremendous effect of the World War on the last cycle. The minor cyclical movements within the major cycles ordinarily cover about the same period as the general business cycle, though they may not be coincident in point of time.

A second striking characteristic of the building-cycle curve is the great amplitude of the major cyclical fluctuations. The curve moved up from 44 per cent below normal in 1878 to 55 per cent above normal in 1890, down to 41 per cent below in 1900, up to 31 per cent above in 1909, down to 78 per cent below in 1918, up to 65 per cent above in 1925, and then down to an estimated point 72 per cent below in 1932. In the entire period shown the lowest point was in 1918, and the highest in 1925. This does not indicate, however, that the amplitude of the cycles are growing greater, but it is rather a result of the shortage that accumulated during the World War and the high rate of building after the war that was necessary to make up this shortage of construction.

It appears that while general business cycles usually fluctuate within a range of 20 per cent above or below normal, the major building cycles fluctuate from two to three times as far from normal.

Considering the minor building cycles, it may be said that the building movement preceded the general business movement in 1878-1879, 1885-1886, 1889, 1892, 1895, 1899, 1904, 1909, 1911, 1912, 1921 and 1929. Building movement may be said to have followed the general business movement in 1887-1892 and possibly at a few other points that are not distinct because of the difficulty of interpreting an annual index. The most outstanding instances of opposite movements in the periods shown are from 1881 to 1885, and from 1925 to 1929. The opposite movements from 1915 to 1919 are readily explained by war-time conditions.

Conclusion

It is believed that the business building-cycle index discussed in this report presents a reasonably good picture of the fluctuations in building activity in the country for the past 58 years. For the purposes of this study it was necessary to make as much use as possible of construction-cost indexes and other data already available; and while many criticisms and difficulties can be pointed out, it is believed, on the basis of checks made with current reports on building activity during the different periods, that the resulting material is representative within the limits discussed.

Letters to the Editor

Unemployed Capital

Sir—In a recent issue of *Engineering News-Record,* in answer to the question of a correspondent from Scotland relative to the cause of the present depression, you professed ignorance. This seems to be hardly consistent with the sound opinions you have expressed in the past on this same subject. Disregarding local depressions due to shifting of centers of trade and manufacture, or a change in the public taste, also those depressions caused by natural phenomena such as crop failures, pestilence, floods, etc., the basic cause of any major depression occurring in either the modern or historical times has never been a mystery. In the opinion of the writer, it can be expressed in one sentence: *the inability of capital to find profitable employment.* "Money is scarce;" in other words, capital is not working. When capital stays idle, of course money cannot circulate—hence the scarcity. Another serious consequence of capital staying idle is widespread unemployment. Idle capital and idle workers, this is the present situation in a nutshell. To prove this, all we have to do is to point to the huge amount of dead gold lying in the vaults of the Federal Reserve banks.

The reason that capital works and stays idle in alternate periods is this: the full employment of capital coincides with or depends upon construction and development activity, such activity being essentially a discontinuous phenomenon. Especially is it true of the present time, when we have a vast capacity for overbuilding due to efficient organization and extensive use of labor-saving machinery, and also a population which tends to stabilize. It is regrettable that international bankers, industrial leaders, politicians and publicists confuse the issue by laying undue stress on such factors as foreign trade, foreign debts and reparations. As a matter of fact, they would have us believe that the present depression was caused by our foreign entanglements. Nothing could be farther from the truth. It is not intended here to deny that foreign factors did not have any influence in the present depression. Nevertheless, this depression would have occurred just the same, irrespective of the intrusion of foreign factors and even if this country happened to be an entirely self-sustaining and isolated unit.

Finally, I would like to ask one pertinent question of the manipulators of stock and commodity exchanges and others who argue that we are on the threshold of a major business recovery: in what direction could idle capital be employed consistent with adequate security and profitable return? If this question can be answered satisfactorily, then we are in sight of prosperous times. If not, business is likely to remain in a depressed state indefinitely, in spite of seasonal spurts. In any event, periodic recurrences of depressions, with their attendant hardships, cannot be avoided, unless we are willing and know how to employ capital irrespective of profits.

John R. Pranin.

Medford, Mass.,
Sept. 16, 1932.

Savings by the Dotsero Cutoff

Sir—I note a misstatement in a news item appearing in the Sept. 15 issue of *Engineering News-Record* wherein the idea seems to persist that the cutoff will effect a distance saving of only 135 miles and that the Denver and Salt Lake Railway, had it been constructed through to Salt Lake City, would have afforded a shorter route than that via the cutoff.

Such is not the case. Our surveys completed last November have shortened the originally surveyed length of the cutoff from 41.70 to 38.71 miles, and the saving in distance via the Denver and Rio Grande Western route will now be about 175 miles rather than 135 miles as stated in the article.

The following are correct distances for the several sections of line:

Route	Miles
(1) Denver to Orestod via D&SL (Using Moffat Tunnel)	128.64
(2) Dotsero cutoff (Orestod to Dotsero)	38.71
(3) Dotsero to Salt Lake City (Via D&RGW)	403.06
Denver to Salt Lake City (new route)	570.41
Denver to Salt Lake City (Present route via Pueblo)	745.10
Saving	174.69

Observe that items (1) and (3) in the foregoing differ from those given previously. This is because different junction points have been established than those of the earlier survey. The only *surveyed* route that we know of from the present terminus of the Denver and Salt Lake at Craig to Salt Lake City is that made in 1925 by the Salt Lake and Denver Railroad promoters, which made the distance from Denver to Salt Lake City via Craig 578 miles as compared with 570 miles via the cutoff and 614 miles via the Union Pacific.

Thus the cutoff will affect the shortest rail distance and will be some 40 miles shorter than stated in the news item.

Final location surveys now in progress may reduce slightly the mileage of the cutoff as shown above.

C. M. Lichtburn,
Valuation Engineer,
D. & R. G. Western R.R. Co.

Denver, Colo.,
Sept. 29, 1932.

Engineering News-Record

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Look Out for Floods

ONCE AGAIN an experience is recorded that reveals the unforeseen magnitude of flood hazards. In the Rio Grande Valley a flood early in September overtopped the highest prior marks by a large margin and washed out trees that had grown undisturbed for nearly a century. In the light of such an occurrence it is obviously futile to rely on short-time experience in estimating flood possibilities; very large allowances must be added to cover the long-time hazard. Especially the Devils River figures which L. M. Lawson reports establish new datum points for the region. Great floods are rare, yet full protection is nevertheless vital, as each year their menace to life and property increases with the growth of river communities. It is correspondingly important that streamflow observations have full public support at all times, since all flood-protection planning depends on them. A safe rule at all times is to look out for higher floods than have occurred in the past.

Costs More, Worth More

THE question "Is it architecture?" will be debated many times this winter in discussions of the new Philadelphia Savings Fund Society building. Beyond making this prophecy we do not dare to venture, contenting ourselves with the more evident statement that as a result of its architecture it is, without doubt, engineering. As architects strive to express function in their structures they make the task of the structural engineer proportionately greater. Outward expression and inward simplicity can be compatible, but they are seldom made so. Complicated framework will not be opposed by the structural engineer on the ground that it is difficult to design; indeed, he thrives on such difficulties. But complicated designs are more costly than simple standardized designs, and under the present pound-price method of paying for structural designs the engineer shoulders the additional cost. If architects and owners persist in expressing themselves and their ideas in their structures, which is quite within their rights and sometimes represents progress, they should pay for the privilege.

Permanent Traffic Lines

THE WHITE LINE that marks the traffic lanes on our main roads is making its presence increasingly felt among maintenance cost items. With the highest development of line-marking equipment and organization these strips of paint in their simplest form cost from 1 to 1½c. a foot. When this expenditure must be repeated from once to half a dozen times a year the total is a sizeable expense item, which ought to be reduced. In the Pennsylvania standards of 1924 (*ENR*, April 10, 1924) a white-cement strip inlaid for concrete surfaces and embossed on the concrete base for bituminous surfaces was specified and constructed on a small mileage. Construction difficulties led the highway department to discontinue the permanent strip, though the specified construction differed in few essential points from the present practice of various other authorities, as described in this issue. A decade ago the highway contractor was not trained in the refinement of detail to which he is now accustomed. Today he undertakes the construction of such marking lines, without risk of delaying the regular stride of his work, at prices of five or six cents a foot —the cost of one year's renewal of paint lines where traffic is dense. The inlaid white-cement traffic line thus has come decisively into the range of construction expedients directed toward reducing maintenance costs.

Success with Hand Labor

IN APPRAISING the experience of the Michigan highway department with hand labor in road construction, great importance attaches to the quality of the engineering direction. As is plain from the account in this issue, hand labor was a success in meeting the particular emergency that confronted the highway officials —the danger that their highway funds would be used for doles unless a more helpful and profitable alternative could be devised. The decision was to offer widespread employment on the state roads by finding as many opportunities as possible for hand labor. And the undertaking was a complete success. The hand-labor operations cost very little more, especially in view of the winter construction, while employment was increased materially. These results are highly creditable. They may be traced back to careful selection of the hand operations, and to the fact that the fundamental purpose was definitely *not* to seek to replace machinery by hand labor, as well as to well-judged engineering planning. The absence of these conditions means certain waste, as many experiences of the past two years have shown.

Incinerators and Engineering

THE MAJOR significance of the new Washington refuse incinerators described on another page lies in their having been built from plans and specifications prepared by independent engineers. The incineration field has been dominated by proprietary interests and competitive sales methods. In more recent incinerator contracts the equipment design has been left in the hands of the bidders, subject to general specifications by the engineer. The Washington authorities have taken the logical next step. The development is analogous to that recorded in the history of water purification and sewage treatment. Those fields were once largely controlled by patent proprietors. After passing through an intermediate stage of manufacturer's design based on general engineering specifications, water and sewage plants became what they are today, products of design and specification by independent engineers, while still offering legitimate opportunities for the use of special equipment. It is likely that incinerators in much the same way will ultimately become engineering products, with over-all efficiency and coordination of units adequately assured by engineering design, while detailed development of mechanical equipment remains a fertile field for the display of manufacturers' ingenuity.

Low-Heat Cement

AFTER more than a year's study, itself based on long prior researches, a radically new specification for portland cement has been written to govern the manufacture of cement for Hoover Dam. Its trend was foreshadowed by the recently published results of investigations at Riverside and Berkeley and the Pine Canyon specification, but it goes well beyond these in respect to both quality requirements and tests. In view of the high rank of the experts who cooperated in drafting it, the specification may be taken as proof that success has been attained in producing cements of low heat evolution that will give good strength and reasonably rapid set.

As to the background of this development: The great concrete masses of Hoover Dam obviously called for a cement that would generate the least possible heat in setting, in order to simplify the problem of controlling the interior temperature of the setting blocks. Heating means expansion and subsequent contraction, and this in turn implies the risk of cracking, which is especially dangerous in dams—several dams of recent years have developed objectionable cracking—but also may be serious in other engineering structures of massive proportions. Hence the importance of keeping down heating, either by the novel refrigerating pipe system projected for the Hoover Dam construction or by the use of low-heat cement. The temperature problem of Hoover Dam was considered so important as to call for both expedients. According to the new specification the desired reduction of heat evolution during the setting of the cement is to be attained by controlling the composition so that a minimum of tricalcium aluminate and a maximum of dicalcium silicate is formed, although where more moderate effect is adequate a large proportion of tricalcium silicate, which produces more heat but also more strength, is allowed.

These innovations have special meaning because they represent a sharp change in the direction of cement progress. For fifteen years or more the art of making cement has been advancing in the direction of greater strength and early hardening, in response to the continuous pressure of engineering demand. The development was largely empirical in nature, but was notably successful; refinement of mill procedure, including thorough burning, overcame difficulties that might have arisen from increased lime content and finer grinding. Many users believed that some of the virtues of the coarser cements of a quarter-century ago, among them high stability, were lost in the change. Nevertheless concrete practice as a whole progressed greatly. In time, however, it came to be recognized that for certain kinds of service the development was in the wrong direction, and the present search for low-heat cement may therefore be regarded as an expression of dissatisfaction with the trend of the recent past and a departure on a new course. Viewed in this way the new specification is a resultant of long accumulating forces, rather than merely a solution of the Hoover Dam problem.

As already suggested, low-heat cement has practical importance far beyond this single application. Its ultimate place in the field of concrete must develop from experience, but even now it is clear that many problems of dam construction and some other cases of massive concrete work offer proper occasion for considering its use. This fact, as well as the significant character of its service in connection with the great work of damming the Black Canyon of the Colorado, suffice to rank it as a lasting development in the cement art.

Above all, the Hoover Dam specification is welcome because it will bring a new and potent inspiration to the art and industry of cement making. There has long been crying need for such inspiration; art and industry alike have suffered from being centered all too much on production, too little on how cements might be made of broadest service to man. Especially in the present era of industrial stress can this inspiration exercise momentous influence, by shaping thought and practice, by reorienting the industry, and by revitalizing the art of concrete making and use.

Housing Gets a Loan

THE GRANTING of a loan by the R.F.C. to the Hillside Housing Corp. in New York adds one more type of construction enterprise to those already recognized as self-liquidating. In many respects the housing loan is one of the most significant yet made. Opposition to it was bitter, but the directors of the R.F.C. concluded that the immediate effect of the loan on employment and business and the ultimate effect on housing improvement in general far overshadowed the arguments brought against it. The Hillside development is not slum clearance. It is not housing for the really low-income group. But it is low-cost housing within the meaning of the New York state law and the Relief Act. And it is modern, large-scale housing financed on a sane basis.

Housing loans are among the most difficult to make. The real estate argument that new housing will damage existing properties must be taken into account, although it is by no means as convincing an argument as its sponsors would have one believe. The question of the amount of the equity money that the limited-dividend companies should put up is a vexing one. The interest rate precedents of the R.F.C. are also a stumbling block. But in spite of these difficulties, there are important reasons why the Hillside loan is justified and why more housing loans should be made.

Large-scale housing offers one of the most potent sources of unemployment relief and business stimulation. The Bronx realtors who charge exploitation of their borough by the R.F.C. overlook the fact that the Hillside project will add 700 employed men and over a million dollars in wages to the asset side of the borough balance sheet. The social aspects and needs of large-scale housing as a means of slum clearance are well known and accepted. And from the long-time standpoint, the effect on housing financing practices in general of a few successful developments forms one of the most compelling reasons for the R.F.C. to grant housing loans.

In sweeping reform of real estate financing lies the only hope for sensible city growth and safe real estate securities. The absurd charge that government aid to housing will result in injury to the building industry has its root in selfish, shortsighted and unsocial reasoning. The only salvation for the building industry is for regulated housing development and financing. Once a few of these housing projects have proved their success and captured the attention of the investing public, equity money will not be difficult to secure. Housing loans by the R.F.C. offer the building industry, and, in fact, the very real estate interests that oppose them, their greatest opportunity for permanent betterment.

NEWS OF THE WEEK

Contracts Awarded for Construction of Golden Gate Bridge

CONTRACTS totaling $12,794,904 for work on the Golden Gate bridge at San Francisco were awarded Nov. 4 by the directors of the Golden Gate Bridge and Highway District. Work is expected to start on the structure within a few weeks. The award came exactly two years after the bond election which authorized a $35,000,000 issue for the bridge, and is the second letting of contracts for all but steelwork of the bridge. Immediate purchase of a $3,000,000 block of bonds by a local banking syndicate with agreement for buying another similar block by Mar. 1 was sufficient evidence of financing ability to provide surety bonding by a group of local representatives of several national companies.

Contracts awarded included: John A. Roebling's Sons Co., fabrication and erection of cables, $5,855,00; Pacific Bridge Co., Portland, main piers, $2,935,000; Barrett & Hilp, San Francisco, anchorages, etc., $1,859,854; Bridge Builders Inc., San Francisco, approach spans, $934,800; Eaton and Smith, San Francisco approach, $996,000; Chigris, Sutsos, Marin approach, $59,780; Alta Electric Co. electric installation, $154,470.

The $10,484,000 contract for the main steel superstructure with the McClintic-Marshall Corp. awarded with the original contracts is still in effect. All other contracts let at that time lapsed during the period of litigation that followed. The award of the paving contract was not made at this time as such work would not start for several years.

Low bidders disqualified

In two instances it was announced that there was irregularity in the low bid and award was accordingly changed by the board. For anchorages and approach piers the low bid of Bridge Builders Inc. ($1,859,854) was held to be conditional and all bids for this unit were rejected and Barrett & Hilp, third low of the bidders for this item ($1,929,598) submitted a new bid at the low figure ($1,859,854) which was accepted. The second low bidder for this unit, Clinton Construction Co., San Francisco, ($1,906,055) protested this award.

Also, the bid of Bridge Builders Inc. for the San Francisco approach road ($996,000) was held to be conditional and the award was made to the next lowest bidder, Eaton and Smith, San Francisco, ($997,892) at the low figure.

The present financing is a special arrangement made by the syndicate headed by the Bank of America in the interest of getting the work started at once. The original offer for the bonds provided for a price of $92 at 5 per cent interest which would make the actual interest rate 5.26 per cent. The legality of this procedure was questioned by Masslich & Mitchell, New York bond attorneys, and a supreme court decision therefor seems necessary. To forestall this delay the bank agreed to take $3,000,000 at once in the way of an advance and await state supreme court decision as to the legality of the original purchase offer. If the original proposal is found legal it will be concluded and as a result $9,000,000 will be made available. If not the syndicate agrees to take another $3,000,000 of bonds, at acceptable terms, on March 1, making at least $6,000,000 available for carrying forward the work.

◆

Louisiana Highway Forces To Be Cut on January 1

About 500 men, or nearly half the present strength of the Louisiana state highway department are to be laid off on Jan. 1 in order to permit the highway commission to commence the redemption of its certificates of indebtedness. The men scheduled to be laid off are largely from the maintenance department. Their places will be filled with workers furnished by the state relief agencies who will be paid at the rate of $1.50 per day from relief funds. This work will be carried on under the direction of skeletonized maintenance gangs.

In addition to the maintenance work on road surfaces, the gangs filled out with workers paid from the unemployment relief funds will clear rights-of-way, build and sod shoulders, clear out drainage ditches and do highway beautification work. It is expected that by working men two and a half days a week it will be possible to provide jobs for 4,000 men.

◆

Two-Thirds of Highway Fund For Relief Work Allotted

Over $72,000,000 of the $120,000,000 provided for highway work under the Emergency Relief and Construction Act had been allotted to the several state highway departments up to the end of October, according to a statement from the Bureau of Public Roads.

The relief act provided $120,000,000 for a temporary advance to the state highway department in addition to their regular federal-aid apportionment, the money to be used primarily for unemployment relief purposes. Allotments are made as required by the state except that 25 per cent of the fund apportioned to each state must remain unallotted until after Nov. 1 so that part of the money will be available for winter work. Repayment of these advances made to the states is to be obtained by the federal government through deduction from the federal-aid apportionment over a ten-year period beginning with 1938. Unlike federal-aid funds, these funds do not have to be matched by like amounts contributed to the highway work by the state but may be used by the state exactly as if they were state funds for matching regular allotments of federal-aid funds.

No Disbursements Made to Date For R.F.C. Loans

COMMITMENTS by the Reconstruction Finance Corporation on 24 self-liquidating projects total $134,634,120 but no disbursements have been made to date. Socalled "clean" loans in which no conditions intervene to delay construction amount to only $2,699,500 distributed among 12 small projects.

Announcement of the loans during recent weeks created the impression that work would go forward immediately on the projects financed on government credit made available under the Emergency Relief and Construction Act to stimulate employment but because of legal, financial and engineering tangles it will be weeks before the dirt starts flying on any considerable scale.

Work started on one project

So far as the R.F.C. is aware, work has actually started on only one of the big projects—the Middle Rio Grande—and this anticipates the favorable outcome of a test suit regarding the bond issue. The Hudson River bridge at Catskill may soon be underway but that appears to be the extent of activity on any of the larger projects in the near future. The conditions which attach to most projects are not formidable but to remove them takes time.

Local approval required

Some misunderstanding has arisen from the fact that, in most cases, the applicants, at the R.F.C.'s suggestion, have submitted their plans before obtaining local or state authorization for the project or the consent of the voters to assumption of the obligation. Conformity with such requirements involves detail that, of course, need not be pursued further if the project is rejected by the corporation. But if the project is approved this work remains to be done, much of it before a spade can be turned.

Legal and financial machinery is cumbersome, slow moving, but cannot be scrapped. A project must wait for election day or the next session of the state legislature, for an audit of the accounts of a city water department, or perhaps a court's decision whether the bonds that the R.F.C. has agreed to purchase may be offered at private sale. One or more of such conditions attach to every project that the R.F.C. will aid in financing.

Much work put on R.F.C.

Another cause of delay in breaking ground on approved projects is the burden of paper work that many of the applicants have thrust upon the R.F.C. after a project has been approved "in the rough" by the board of directors. As many of the applicants are small municipalities governed by city councils or boards of aldermen, experience is wanting and the staff of the R.F.C. is forced to roll up its sleeves and do the work that ordinarily falls to the borrower of private capital. Although the

R.F.C. has approved 24 projects, only 9 contracts have been formally ratified. With respect to the others various conditions still are being debated or many details remain to be perfected. Announcement of loans usually is made as soon as the applicant has agreed to the interest rate and other terms stipulated by the R.F.C. A suggestion that the R.F.C. defer announcement of loans until, at least, all conditions have been agreed to and contracts formally approved is regarded as impractical because the R.F.C.'s initial decision to make the loan invariably receives wide publicity locally.

As premature ballyhoo cannot be avoided, the proposal has been made unofficially that to speed work on the self-liquidating projects which the corporation has agreed to finance, local bankers cooperate by making short-term advances against the loan where such cooperation would serve to furnish immediately the employment that the construction of self-liquidating works was designed to create.

Projects ready to start

The projects on which no appreciable delay is expected in the requisition of funds and undertaking of work, together with the securities offered the R.F.C., are as follows:

City of Wilmette, Ill.—waterworks—$580,000 of revenue bonds.

City of Conneaut, Ohio—waterworks—$200,000 of revenue bonds.

City of Sandusky, Ohio—sludge basin—$77,000 of notes.

Roanoke Rapids Sanitary District, N. C.—water and sewage system—$365,000 of general obligation bonds.

City of Prescott, Ariz.—reservoir dams—$50,000 of general obligation bonds.

Savanna-Sabula Bridge Co. (Illinois-Iowa)—completion of toll bridge—$190,000 of 3-year notes. The applicant intends to procure funds elsewhere to complete construction. The R.F.C. has agreed then to advance the cost of such completion, taking notes secured by mortgage bonds.

City of Gulfport, Miss.—cotton compress and warehouses—$150,000 of bonds.

City of Covington, Ky.—waterworks improvement—$75,000 of bonds.

Wanakah Water Co., Hamburg, N. Y.—waterworks extension—$70,000 of bonds.

Madison Heights (Va.) Sanitary District—waterworks—$62,500 of bonds.

City of Bowling Green, Ky.—sewer system—$630,000 of bonds.

City of Hobart, Okla.—waterworks dam—$250,000 of bonds.

Projects held up

Projects on which disbursement of funds and commencement of construction work depend upon conditions that have not yet been fulfilled are as follows:

State of Louisiana; Public Belt Railroad Commission—bridge—$13,000,000 of general obligation bonds. Waiting upon completion of satisfactory toll contracts with railroads for use of bridge and preparation of complicated mortgage indenture.

California Toll Bridge Authority (San Francisco Bay Bridge)—bridge—$62,000,000 of general obligation bonds. The conditions upon which this loan was authorized require legislation by the State of California with respect to approaches and otherwise which may not be enacted before next spring.

City of Madison, South Dakota—municipal electric light and power plant—$105,000 of revenue bonds. City Council has refused corporation's offer to purchase 5 per cent bonds at par and at given schedule of maturities; election will be necessary to authorize bonds in event of agreement between city and the R.F.C.

Middle Rio Grande Conservancy District—flood control, drainage and irrigation system—$5,784,000 of general obligation bonds. The conditions upon which this loan was approved by the corporation require the favorable outcome of a test suit to be brought in the New Mexico courts to establish the district's right to issue bonds on the terms proposed. Applicant has already started work because it anticipates favorable outcome of test suit.

City of Ogden, Utah—water works—$645,620 of revenue bonds. The conditions upon which the corporation authorized this loan require the favorable outcome of a test suit to be brought in the Utah courts to establish the city's power to issue revenue bonds of the type offered.

City of Columbia, Ky.—completion of waterworks system partly constructed—$29,000 of revenue bonds. The conditions upon which the corporation authorized this loan require that inspection of the work already constructed shall be satisfactory to corporation's engineers.

City of Seattle, Wash.—reservoir and water mains—$1,491,000 of revenue bonds. The conditions upon which this loan was authorized by the corporation require an audit of the accounts of the water department by the revenues of which the corporation's loan is secured, and the adoption by the municipality of ordinances legally authorizing the proposed construction.

Maysville Water Co., Maysville, Ky.—filtration plant for private water works—$47,000 of notes. Applicant requested funds available thirty days after approval of loan. Terms of loan and mortgage to secure it now being prepared.

Metropolitan Water District of Southern California—aqueduct—$40,000,000 of bonds. No bonds expected to be offered the corporation for purchase until November. An injunction suit, on behalf of taxpayers in water district, pending against purchase of bonds by corporation.

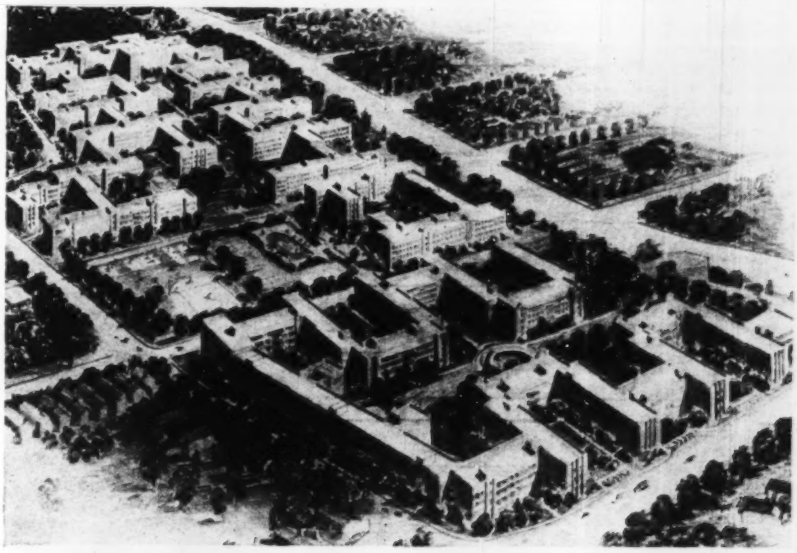
Hillside Housing Corp., Bronx, New York.—housing—$3,957,000 of bonds. The terms on which this loan was approved by the R.F.C. differ in some respects from those set forth in the application to the New York State Housing Board. The changes must be approved by the state board before any advance can be made by the R.F.C.

Maverick County Water Control District, Eagle Pass, Texas.—irrigation canal and power plant repairs—$1,476,000 of bonds. Applicant required to procure subordination of the lien of $2,709,000 bonds now outstanding in private hands. Applicant also must make provision for Jan. 1 interest coupon on such bonds.

New York State Bridge Authority—highway toll bridge at Catskill, N. Y.—$3,400,000 of bonds. Conditioned upon enactment by state legislature of certain amendment to statute authorizing construction.

The type of bond which the Reconstruction Finance Corp. has agreed to purchase—whether general obligation or revenue—is indicated above in cases where the corporation would disclose this information. When only the notation "bonds" appears, no further description is available because the corporation decided during the past week not to make it public. It is understood that the corporation's decision was influenced by the number of protests from taxpayers in the municipalities concerned against the use of general obligation bonds in financing self-liquidating projects.

Since this summary was prepared the supreme court of the District of Columbia has dismissed the injunction suit brought against the R.F.C. to keep it from loaning money to the metropolitan Water District of Southern California.



NEW YORK HOUSING DEVELOPMENT FINANCED BY R.F.C. LOAN

Money to be made available to the Hillside Housing Corp. through the loan granted last week by the Reconstruction Finance Corp. will build an apartment house village in the Bronx, New York City, modeled upon experience gained in designing and operating the well-known housing enterprises at Sunnyside, Long Island and Radburn, New Jersey. Hillside will, like Radburn, eliminate all streets not needed for through traffic and will utilize pedestrian underpasses at all necessary street crossings. Houses themselves will front on landscape courts, and automobiles will be brought only to the rear of the houses as at Radburn.

The site to be developed involves about 25 acres in the northeastern section of the Bronx and is bounded by the Boston Post Road, 213th St., Eastchester Ave., and Hicks Ave. There will be 105 units, 100 of them being 4-story walkups and the others 6-story elevator structures. The elevators will be tenant-operated. The buildings will cover 34 per cent of the ground area, and the remaining 66 per cent will be landscaped. A 2½-acre playground will include a wading pool and other play facilities for children. There will be 1,581 apartments with a total of 5,250 rooms. Each apartment will be two rooms deep and so arranged as to give direct cross-ventilation in every room. The apartment units will consist of two, three, four and five rooms with three and four room apartments predominating. Living rooms will contain about 220 sq.ft. and bedrooms about 160 sq.ft. Kitchens will be equipped with mechanical refrigeration and gas ranges. A central incineraton system will take care of garbage disposal. The average rental will be $11 per room per month.

Plans for the Hillside development were made by Clarence S. Stein, architect of Sunnyside and Radburn, and Andrew J. Eken, vice-president, Starrett Bros. & Eken, developed the engineering features of the project. The R.F.C. conditions have to be approved by the state housing board before the money becomes available.

Seatrain Service Extended to New York-Havana Run

The launching of two new freight-car carrying ships, *Seatrain New York* and *Seatrain Havana* at the Chester, Pa., plant of the Sun Shipbuilding and Dry Dock Co., and the inauguration of service between New York and Havana early in October marks the first expansion of a unique transportation plan inaugurated in 1929 with a single ship of revolutionary design plying between New Orleans and Havana. The new ships, practically identical with the original one which was built in England have been financed by a U. S. Shipping Board loan and will make weekly sailings from New York and Havana when both are put in service. Each ship is 475 ft. long and has a capacity of 100 fully-loaded freight cars on its four decks. Port facilities consist of large overhead cranes which transfer the cars in a special cradle from the track on shore to the proper track and deck in the ship where they are securely fastened by rail clamps and side jacks. The ships, their system of operation and the novel crane structure at the New Orleans wharf were described in detail (*Engineering News-Record,* Sept. 5, 1929, p. 368). This crane had to be located some 200 ft. off-shore in the Mississippi River to secure sufficient depth for the ships to dock. In order to save foundation expense the crane-rail girders were cantilevered out over the ship instead of being supported on both ends. Hinges at the points of support permitted the girders to be raised to clear the masts and deck houses of the ship while it was being docked.

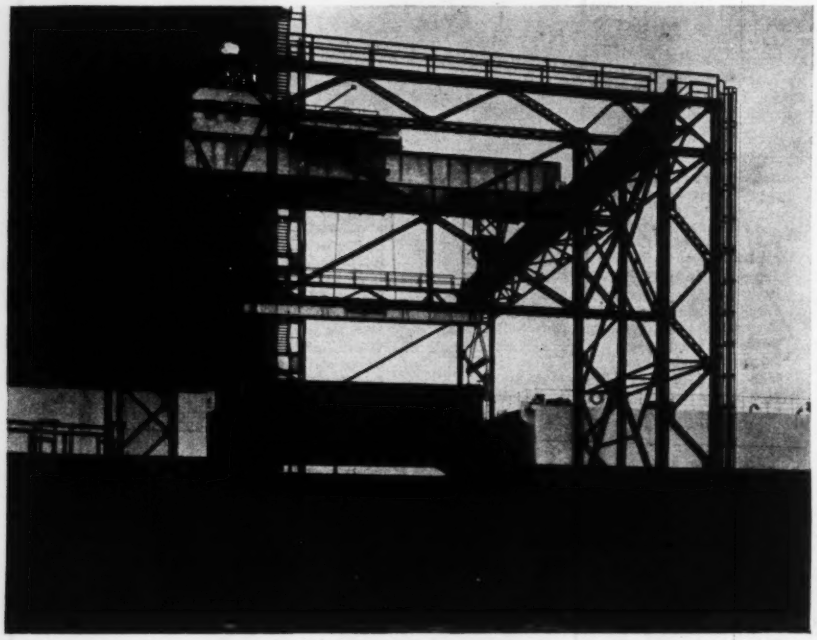
A more simple crane structure is possible in New York where slips are available which can be spanned by fixed crane-rail girders at such a height as to clear the ship superstructures. There the cars are spotted by a switch engine working on the pier over a steel cradle set flush with the pier deck. The crane spanning both the track and the ship then swings the cars directly to the ship's hold.

The Seatrain service brings the Cuban and American railroad systems into a complete unity. Graham M. Brush, president of Seatrain Lines, Inc., the operating company, in discussing the New Orleans-Havana Service at the recent launching of the new ships pointed out how gondola cars take Alabama coke to Cuba and return with manganese ore, rock asphalt and scrap iron, how tank cars carry lard, cottonseed oil, vegetable grease for soap manufacture, gasoline, kerosene and lubricating oils to Cuba and return with molasses for cattle feed manufacturers, how perishable goods are shipped straight through in refrigerator cars, how grains and machinery move in box cars and how flat cars have permitted Southern lumber manufacturers to triple their business in Cuba. Sugar is shipped to the United States in bulk in paper-lined cars. Rates are to be the same as those charged by existing coastal steamship lines but handling costs at the ports are greatly reduced, according to the Seatrain Company's experience at New Orleans and Havana.

Inauguration of the service has been strongly opposed by the railroads of the eastern part of the country. Nine of them made applications to the Interstate Commerce Commission for permission to put into effect on a one-day notice non-acceptance of traffic consigned to Seatrain Lines, Inc. because the latter was reported to be planning to put special tariffs into effect with less than the statutory notice time, under special permission from the commission.

The application was denied by the commission on the ground that no compelling reason for such a proposal had been shown.

The 125-ton crane at New York, shown in the accompanying photograph was built by the Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.



Standard railroad box cars after being run onto a cradle suspended from a 125-ton crane that spans the slip in which the Seatrain lies, are swung out over a hatchway, as shown here, and then lowered into the hold of the ship.

Soil Mechanics Course at Harvard Engineering School

A course in soil mechanics is being offered by the Harvard Engineering School. The first part of the course will be devoted to a study of the physics of soils and the second part to the application of these principles to foundation work. A laboratory is being equipped for the use of students in the course and opportunities are offered to advanced students to engage in fundamental research in this field.

Arthur Casagrande, former co-worker with Prof. Karl Terzaghi, is to give the course and be in charge of the laboratory. Recently Mr. Casagrande resigned his position as research assistant and research specialist in soils in the U. S. Bureau of Public Roads. He spent six years in the latter position.

Unique Bidding Plan for Montclair Scavenger Service

As a result of a demand for reduction of town expenses and allegations that the scavenger service rendered by the town would cost less under contract, bids are to be received Nov. 10 by the town of Montclair, N. J., for the collection, transportation out of town and final disposal of garbage, rubbish and ashes. Basic bids will be on a 5-year and 3-year contract for the work as now being done. To show the town authorities and citizens what savings might be effected by curtailing and simplifying the work required bidders will be asked to state deductions from the basic price if (1) garbage from private houses were collected twice instead of thrice a week from Dec. 1 to May 1; (2) if householders carried ashes and rubbish (but not garbage) to the curb; (3) if a mixed collection were made, either all three classes or else ashes and rubbish only, instead of having three separate collections. Under the existing system garbage is collected daily from food stores, restaurants and apartment buildings and from the business district there are extra collections of ashes and rubbish. This practice will be continued under contract.

The successful bidder must take over a dumping area for rubbish and ashes (used chiefly for rubbish), and pay the owner of the dump $150 a month for rent and maintenance until Oct. 1, 1935. The contractor must also take over the town's collection equipment at a set price of $9,275 and must give a surety bond of $250,000 for a 5-year and $150,000 for a 3-year contract.

The population of Montclair was 42,017 in 1930. The cost of the scavenger service in 1931 was $124,000. The appropriation for the work this year, with minor changes, was $112,000. The town delivers the garbage to hog feeders, gratis, and uses most of the ashes for filling, within the town limits. The average haul of the ashes and rubbish is about ten miles.

The scavenger service is under W. H. Warnock, town engineer, with J. B. Hayden assistant engineer in charge and F. Jennings as superintendent. The specifications as originally drawn called for bids on the work as now being done by the town. They were expanded to include various alternatives on the advice of a citizen's survey committee of which M. N. Baker is the engineer member.

Use of Lumber in Construction To Be Subject of New Study

A committee to study new uses for wood in construction has been appointed by the Secretary of Commerce as a subcommittee of the National Committee on Wood Utilization. It is composed of 14 nationally known engineers, architects, builders and contractors and is headed by H. N. Bennion, director of engineering, of the National Electric Light Association.

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Improvements in Street Drainage at New Orleans Projected

Following the heavy rainfall in New Orleans on Oct. 25, Bryson Vallas, of the sewerage and water board, announced that plans for improving the drainage from frequently-flooded districts in New Orleans were to be considered at the November meeting of the board.

For the 20-hour period of the rain more than 4 in. fell; 3.56 in. of this amount was concentrated in the two hours between 9:45 and 11:45 p.m. and in one ten-minute period the fall amounted to 0.78 in. or at a rate of 4.68 in. per hour.

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Contracts for Federal River Work and Housing Receive Approval

Contracts for river and harbor work and for army housing totaling over $1,200,000 were approved by the Chief of Engineers and the Quartermaster General on Nov. 2. The largest contract for river work was $793,488 to the Maxon Construction Co., of Dayton, for work at lock and dam No. 20 on the Mississippi River at Canton, Mo.

A contract to Worsham Bros. of Knoxville, Tenn., for $333,100 for the construction of two barracks for the Air Corps at Barksdale Field, Shreveport, La. was among the housing contracts approved.

The Chief of Engineers, on Nov. 3, approved a contract of $1,571,925 let to the Dravo Contracting Co. of Pittsburgh for the construction of Lock B, the second of the twin locks, a roller-gate dam, alterations to the upper miter-gate of existing Lock A, a power house on the river wall of Lock A, and the installation of power house machinery on the Kanawha River at London, W. Va. A contract for dredging Sparkman channel, Tampa Harbor, Fla., let to the Spadaro Contracting Co. and to George Colon & Co., New York, for $185,568 also was approved.

Among other contracts approved was one of $463,185 to the Trinity Farms Construction Co. for levee work in the Lower St. Francis Levee District.

On Nov. 5 the Chief of Engineers approved award of a contract of $503,980 to the Standard Dredging Co. of New York, for dredging the Delaware River at Port Richmond anchorage and $950,755 to the Arundel Corp. of Baltimore for dredging in the intra-coastal waterway from Jacksonville to Miami, Fla.

Contract for $133,504 was awarded to the American Dredging Co. of Philadelphia for dredging in the Schuylkill River channel, and a contract of $252,807 went to the Great Lakes Dredging & Dock Co., of Cleveland, for work in the Livingston channell in the Detroit River.

Morris Knowles Dies, Prominent Pittsburgh Engineer

Morris Knowles, consulting engineer of Pittsburgh, Pa., a leader in national engineering circles and an active figure in progressive public movements in his city and elsewhere, died of a heart attack in his home in Pittsburgh on Nov. 8. Mr. Knowles had been in failing health for some time but had continued to take an active part in the work of his firm, Morris Knowles, Inc., and in professional matters. He also continued to take an active interest in the many public bodies in which he had been called to serve.

Born in Lawrence, Mass., in 1869, Morris Knowles received his bachelor's degree from Massachusetts Institute of Technology in 1891. His active engineering began before he entered college, however, as he spent the vacation periods of 1887, 1888 and 1889 as an assistant in the engineering department of the Essex Water Co. After graduation he was for a time with the East Jersey Water Co. and Massachusetts State Board of Health studying the metropolitan water supply. From 1895 to 1897 he was with the Metropolitan Water Board of Boston and in 1897 went to Pittsburgh to become resident engineer of the filtration commission.

The period from 1899 to 1901 was spent in various water supply studies including Philadelphia, New York and Lawrence, Mass. In 1901 Mr. Knowles returned to Pittsburgh to become engineer of the filtration works, Department of Public Works, and the following year became a member of the firm of Chapin & Knowles, consulting engineers, Canton and Pittsburgh. Upon the death of Mr. Chapin in 1915 he acquired control of the business.

He served as a member of the advisory board of engineers, Miami Conservancy District; supervising engineer during the war in the construction of Camp Meade and Camp McClellan, and chief engineer of the Housing division, U. S. Shipping board; as a member of the Engineering Board of Review, Chicago Sanitary District; member of the Zoning Commission, U. S. Dept. of Commerce; chairman of the City Planning Commission and Board of Zoning Appeals of Pittsburgh. In professional matters he has served as a director of the Am. Soc. C.E. and has been active in its committee work for many years.

Morris Knowles was noteworthy for his fairness, breadth of vision and interest, and in his helpfulness and friendly attitude toward all. These qualities, coupled with tireless activity, distinguished his professional and private career no less than his high engineering ability and judgment.

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General Siebert's Resignation Caused by Economy Ruling

The resignation of Major General William L. Siebert from the advisory board of engineers for the Colorado River work, as noted in our news pages last week, was the outcome of a ruling by the Comptroller General that under the economy act General Siebert, whose pay as a retired army officer is in excess of $3,000 a year, could not draw the $50 a day allowed the consulting board while acting on the Colorado River work at the same time he was drawing his retired pay.

Long Tunnel Holed Through on Owyhee Irrigation Project

Tunnel No. 5, 4½ miles long, on the Owyhee irrigation project of the Bureau of Reclamation, was holed through on Oct. 30. Concreting of the inlet end of the tunnel to a 9-ft. 3-in. horseshoe section was finished last February, twenty months ahead of schedule but due to heavy ground with inflows of sand and water which required the use of steel liner plates through 6,636 ft. of the 10,982 ft. in the lower half of the tunnel, work has been delayed there. However, the lining will be finished by spring. Lining of tunnel No. 1 was completed about Nov. 1 and bids for the control works will be opened late in November.

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Power Commission Hears Plea for Use of Niagara River Water

The Federal Power Commission, on Nov. 3, listened to the opposing claims of the Niagara Falls Power Co. and the city of Lockport, N. Y., for the use of 275 sec.-ft. diverted from the Niagara River for power purposes at Lockport, N. Y. The water in question is diverted from the river into the New York state barge canal at a point near Tonawanda, N. Y., and has been used for the development of power at Lockport, N. Y. It is covered by the treaty with Canada. A few years ago the Niagara Falls Power Co. obtained control of the power company using the water and has been using an equivalent amount of water for power development at Niagara Falls under a temporary permit from the power commission. The city of Lockport wants the water for a municipal development plant there and claims that under the preference given to municipalities in the Federal Water Power Act a license to use the power should be granted to it rather than to the Niagara Falls Power Co.

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Loan Sought for Railroad from St. Louis to Kansas City

A loan of $35,000,000 from the Reconstruction Finance Corp. for construction of a new line between St. Louis and Kansas City, Mo., has been applied for by the St. Louis-Kansas City Short Line Railroad. The law does not embrace loans for new construction but the company, which was incorporated in Missouri in 1924, has informed the Interstate Commerce Commission that $265,000 has already been spent for rights-of-way, surveying, engineering and statistical work, and that the project was ready for financing when the money market collapsed in 1929. Construction by the company two bridges across the Missouri River was authorized at the last session of Congress.

The double-track line would be 236 miles long, as compared to the Missouri Pacific route of 278 miles. The company contends that the territory between Missouri's principal cities is inadequately served by circuitous lines of cheap construction and heavy grades. The security offer is a first mortgage on all the property, including construction costs and the rights of way on which the company values its equity at $7,000,000 but for which $340,000 is needed in addition to the amount already spent.

Sanitary Engineers of North Carolina Hold Joint Meeting

MORE than 300 engineers and officials from 12 states were in attendance at the twelfth annual convention of the North Carolina section of the American Water Works Association and the North Carolina Sewage Works Association at Winston-Salem on Oct. 31, Nov. 1-2. Discussion of the papers that were presented was participated in to such an extent that all sessions ran an hour or more overtime.

In line with the times, subjects that had to do with operating economies and means of showing better financial results were especially well received. Policy in regard to charges to other municipal departments for water service was shown in the discussion to vary between wide extremes. Durham, N. C., charges all its municipal departments for water furnished them. A standby charge for fire hydrants is included. On the other hand, officials of some cities represented stated that practically all their water service to other departments is given free. The consensus of the extended discussion was that the tendency toward charging for all public water service rendered was growing rapidly.

Improved methods of coagulation at the Richmond, Va., filtration plant were described by M. C. Smith, engineer of the department of public utilities of that city. He stated that the new coagulation methods had saved $23,000 in the cost of chemicals in the first eleven months of operation, $5,000 more than the cost of the installation.

The discussion of Mr. Smith's paper brought out that mechanical devices for producing better coagulation have been used extensively on the Pacific Coast for some years. Harry N. Jenks, professor of hydraulic and sanitary engineering at the University of North Carolina, described an installation of this sort made at Sacramento about ten years ago. Mention also was made in the discussion of three other installations in the East similar to the equipment at Richmond.

Mark B. Owen, superintendent of public works of Dearborn, Mich., in summarizing results of the first six months operation of the combined chemical-precipitation and mechanical-handling sewage treatment plant in that city, stated that the results that have been obtained so far have been entirely satisfactory. He stated that he believed that the showing of the plant will continue to improve, but that at no time will it be practical directly to compare the operating costs with those of biological plants of similar capacity. This is due, he stated, to the fact that a large part of the load on the plant is Imhoff tank sludge from a separate biological plant.

No trouble has been experienced with the sludge from the precipitation-mechanical plant, except for odors when the sludge from the Imhoff tanks arrives during a period when the sewage reaching the latter plant is highly septic. Plans are under consideration for incinerating the sludge from the precipitation-mechanical plant.

For four years H. G. Baity, professor of civil and sanitary engineering of the University of North Carolina, and his associates, have been conducting field experiments in cooperation with the Chlorine Institute to determine the effects of sewage chlorination on the receiving stream. These experiments show that the physical appearance of the stream is improved; that noxious odors are allayed; that the dissolved oxygen condition in the critical section of the stream is improved; that b.o.d. reduction ranging from 25 to 40 per cent is obtainable and that bacterial reduction in the stream ranges from 90 to 99 per cent. Dr. Baity pointed out also that some of these changes might not be desirable from a strictly scientific viewpoint, since natural purification processes are delayed. On the other hand, objections from property owners along the stream may thus largely be overcome.

Minimum stream flow conditions in North Carolina in 1932 have been studied specially in the cooperative work done in the state by the U. S. Geological Survey and the North Carolina Department of Conservation and Development. Charles J. Ray, Jr., chief engineer of that department, in a paper on the subject brought out that ground-water storage reduction due to deficient rainfall in 1930 and 1931 was evidently as much responsible for minimum low flows of several streams as was the subnormal 1932 precipitation. These two governmental agencies some time ago began the study of ground water variations and reserve conditions in North Carolina. Observations are being made regularly on 25 wells.

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SOCIETY CALENDAR

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Washington, D. C., Nov. 14-18.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, Detroit, Mich., Jan. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, annual convention and road show, Detroit, Mich., Jan. 16-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS annual meeting, New York, N. Y., Jan. 18-21.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Detroit, Mich., Jan. 16-20.

AMERICAN TOLL BRIDGE ASSOCIATION, annual meeting, Camden, N. J., Jan. 16-17.

ASPHALT INSTITUTE, Asphalt Paving Conference, New Orleans, La., Dec. 5-9.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, annual convention, Detroit, Mich., Jan. 16-18.

HIGHWAY RESEARCH BOARD, National Research Council, Washington, D. C., Dec. 1-2.

HIGHWAY AND BUILDING CONGRESS participated in by twenty national engineering societies and trade associations, Detroit, Mich., Jan. 16-20.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, Detroit, Mich., Jan. 16-18.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Ottawa, Ont., Feb. 7-8.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS, annual meeting, Hot Springs, Ark., Nov. 15-18.

NATIONAL CONFERENCE ON CITY PLANNING, annual meeting, Pittsburgh, Pa., Nov. 14-16.

NATIONAL CRUSHED STONE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

NATIONAL READY MIXED CONCRETE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 18.

NATIONAL SAND & GRAVEL ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

PORTLAND CEMENT ASSOCIATION, Detroit, Mich., Jan. 16-18.

Personal Notes

ARTHUR O. TOMEK has resigned as city engineer of Two Rivers, Wis. The city engineer's duties as well as those of building inspection have been combined with those of city manager.

HUGH T. HAZEN, assistant engineer, Canadian National Railways, Montreal, has been appointed chief engineer of the Atlantic region of the system, to succeed A. F. **STEWART**, who has been retired after more than 30 years of service with the company. In recent years Mr. Hazen has been in charge of the construction and repair of the railroad's car-ferry terminal.

SIR MURDOCH MACDONALD, vice-president of the Institution of Civil Engineers, Great Britain, has been named president of the institution by the council because the poor health of **SIR DUGALD CLERK**, recently elected president, prevents him assuming the office. Sir Dugald is 78 years of age. He has agreed to remain in the office of vice-president for the year 1932-33.

JEAN H. HAWLEY, New York, has been appointed assistant director of the Coast and Geodetic Survey to succeed the late Robert Lee Faris. Commander Hawley has been with the Coast and Geodetic Survey for 25 years. Recently he was in charge of the survey's work in the Philippine Islands. Mr. Hawley was born at Bolton, N. Y., and received his degree in civil engineering from Clarkson College of Technology at Potsdam, N. Y.

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Obituary

FRANK O. HODSON, engineer and paving contractor of Gary, Ind., died there recently, age 61 years. Formerly he was assistant city engineer of Gary.

WALTER M. PETERS, vice-president of Bilhorn, Bower & Peters, Inc., contractors on river work at St. Louis, Mo., died at University City, Mo., on Oct. 30, age 59 years. Following the war Mr. Peters was with the engineering department of the Chicago, Burlington & Quincy R.R. and later was with Woods Bros. Construction Co.

OSCAR CLAUSSEN, former commissioner of public works and chief engineer of the City of St. Paul, died there on Oct. 26, age 71 years. Mr. Claussen was the last engineer commissioner of public works and the first chief engineer under the new form of government which went into effect in St. Paul in 1914. He resigned as chief engineer in 1922.

JOHN W. LEDOUX, consulting hydraulic engineer, Philadelphia, died there on Nov. 7 as the result of an automobile accident the preceding evening. Mr. Ledoux was 72 years old. He was born in St. Croix Falls, Wis. and graduated from Lehigh University in 1887. Immediately following graduation he went to work with the American Pipe and Construction Co., becoming chief engineer in 1890. He remained with the company 30 years and during that time is credited with having designed most of the many water supply systems built by the organization. For the past 12 years Mr. Ledoux has been in consulting work specializing in water supply work. In 1919 he received the Longstreth Medal of the Franklin Institute for water meter design work. He was a vice president of the Simplex Valve and Meter Co.

Brief News

New Records for Placing Earth in levees were established on the Mississippi River work in September when a total of 18,378,600 cu.yd. of earthwork were completed. This exceeds the previous record set in August by 790,000 cu.yd.

A Two-Shift Plan of construction as a means of unemployment relief is to be tried on one of the new school buildings to be built by the public improvement commission of Baltimore. Provision for two shifts will be incorporated in the specifications. As now proposed, two six-hour shifts daily will be employed until winter sets in and after that two five-hour shifts. No workman will be permitted to work on both shifts.

Raising the Water Level of the Ohio River at Louisville, Ky., through the construction of a power and navigation dam there four or five years ago, has resulted in numerous suits over the flooding of land above the dam. The latest suit is from the owners of land on Six Mile Island for the loss of the use of shorelines and inability to land a barge at the island for the transfer of live stock. To date about fifteen similar suits have been filed and more are expected.

Improvements in the Waterworks System of Dallas, Texas, amounting to $1,764,000 are to be carried out over the next six years without resort to bond issues, according to an announcement made recently by John Winder, superintendent, and former engineer of the department. Since the council-manager form of government went into effect in Dallas in May, 1931, the system has been put on a cash basis and, on Oct. 1, reductions in rates were put into effect.

Charging a Toll on the high viaduct which the Jersey State Highway Department is building across the Newark meadows has been abandoned as a plan for refunding part of the cost of the viaduct. Because federal-aid funds were used to defray part of the cost of the viaduct, and because tolls may not be charged on roads built with federal funds, the difficulties involved in reassigning the funds for the viaduct and for the roads leading to it make the charging of a toll impractical.

Limits to the Size of Trucks operating on the highways of Alabama are to become effective on June 6, 1933. Recently the governor signed a bill which establishes a maximum weight, with certain limitations, of 20,000 lb. and a height of 12 ft., a width of 96 in., and a length of 30 ft. without trailer and 40 ft. with a trailer. The speed limits set is 20 miles an hour within city limits and 30 miles an hour outside.

For Deepening Channels in the Detroit River, the War Department has allotted the sum of $795,000 under the provisions of the emergency relief and construction act. The proposed work involves excavation at Fighting Island Channel, the channel at the head of the river, and the channel below Livingston Channel.

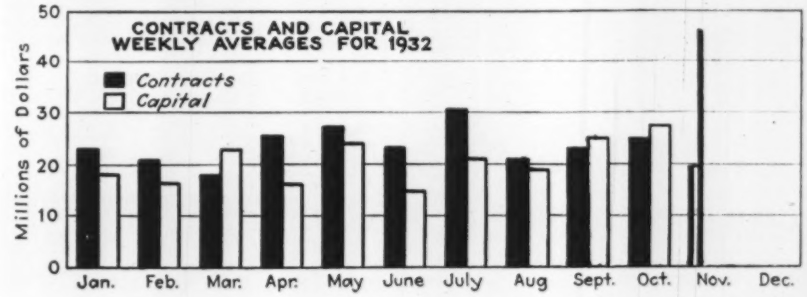
Engineering Contracts and Capital

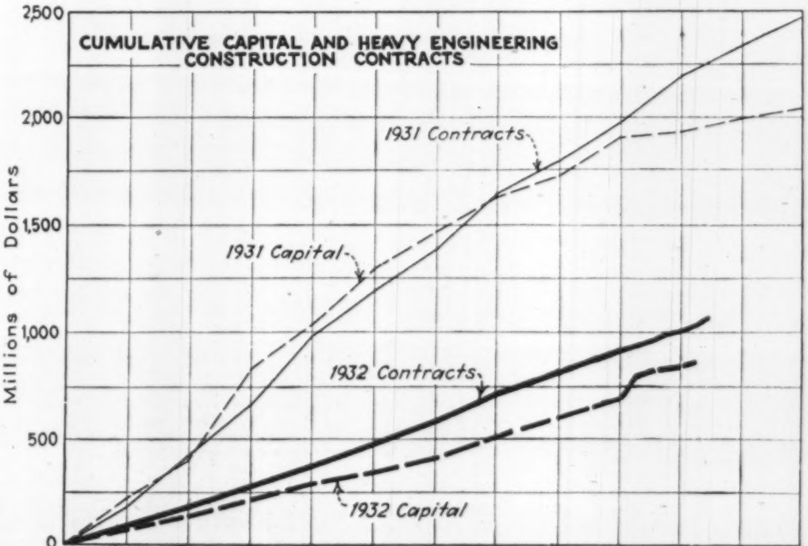
Heavy engineering construction contracts reported for the past week total $46,268,000, the largest weekly volume reported so far in 1932. State and municipal contracts at $31,378,000 account for this increase although both Federal Government awards of $8,021,000 and private awards of $6,869,000 are above the average rate.

Bridges total $24,472,000 compared to $800,000 last week. Increases are recorded in commercial buildings to $5,077,000, in public buildings to $4,088,000, and in industrial buildings to $1,530,000. A slight recession from recent highs is recorded in highway lettings which total $7,034,000, as well as in earthwork, irrigation and drainage which total $3,216,000 for the week.

San Francisco tops the list of awards with the Golden Gate Bridge, $23,289,000. This contract alone amounts to 50 per cent of the week's total. Other large awards include state highway awards in Oklahoma, $1,050,284; U. S. Engineers awards of earthwork on levees in the Memphis district, $463,185; Lock B including dam, power house and machinery, London, W. Va., $1,571,925; and lock and dam at Rock Island, Ill., $793,488; state highway bridge, California, $523,639; and U. S. Navy, Bureau of Yards and Docks, improving power plant, Brooklyn, N. Y., by day labor, $585,000.

Reletting the Golden Gate Bridge contracts requires a downward adjustment of the 1931 contract figures by $21,852,139.





Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Nov., 1931	Weekly Average Nov., 1932	Week Nov. 10, 1932
Federal government...	$5,556	$7,725	$8,021
State and municipal...	14,952	20,757	31,378
Total public........	$20,508	$28,482	$39,399
Total private.......	14,182	4,451	6,869
Week's total........	$34,690	$32,934	$46,268
Cumulative, Jan. 1 to date:			
1931 construction....................			$2,259,666
1932..............................			1,081,374

Decrease 52 per cent.

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Average Nov., 1931	Weekly Average Oct., 1932	Week Nov. 5 1932
R.F.C. loans..........	....	$16,800	$8,203
New capital issues.....	$17,000	11,000	10,749
Total..............	$17,000	$27,800	$18,952
Cumulative, Jan. 1 to date:			
1931 new capital......................			$1,941,000
1932 R.F.C. loans...	......	$132,903	
1932 new capital....	......	726,749	
1932 total............................			$859,652

Decrease, 56 per cent.

ENR Cost and Volume Index

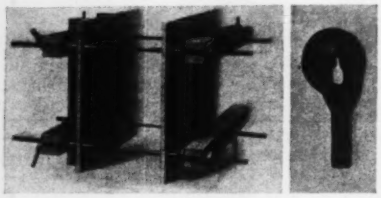
Cost		Volume	
November, 1932	**158.20**	**October, 1932.....**	**137**
October, 1932....	159.16	Sept., 1932........	124
November, 1931.	169.28	October, 1931......	229
1931 (Average)...	181.35	1931 (Average)....	220
1930 (Average)...	202.85	1930 (Average)....	260
1913 Average.......	100.00		

Construction Equipment and Materials

Combined Washer-and-Nut Form Clamp

A new form clamp assembly consisting of two outside rods drilled and tapped to take an inside tie rod threaded at both ends is announced by the Universal Form Clamp Co., Chicago, Ill. Fastenings consist of a combination nut and washer with a handle. The fastener is cast with a keyhole opening, the rectangular portion of which is large enough to allow it to slide easily along the rod. The half round portion of the opening is cast with threads designed to allow the casting to be seated anywhere on the threaded rod. The pressure of the wale against the casting locks it on the rod so that it cannot be removed without a full turn backward.

When the assembly of two outer rods and inside rod is in place in the form, the casting is slipped over the rod within one or two threads of the wale, where it is seated and given one or two turns to draw the form into line. To remove the outside rods an extra casting is applied to bear against the casting already in place acting as a lock nut. The rod can then be backed off of the inner tie by turning the first casting.



New form clamp assembly by Universal Form Clamp Co.

In spacing the forms the sides are temporarily spaced at the top and bottom and before clamping, standard castings are seated on the rod with their faces out and flush with the outer edge of the studs. The outside casting is then set against the wale which has been toenailed to the studs, so that this wale is gripped between the two fasteners.

Spi-Ro-Loc clamps, as they are called by the maker, are supplied for $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{5}{8}$ in. rods.

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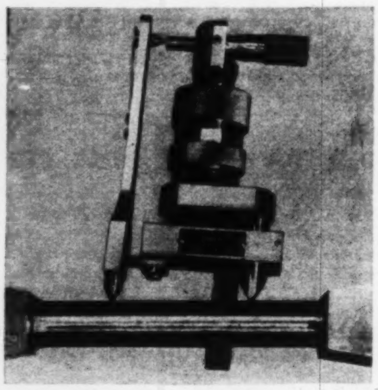
Sensitive Extensometer for Determining Yield Point

A new testing device known as the Oxweld Extensometer for determining the yield point of specimens being tested in an Oxweld portable tensile testing machine, has been announced by the Linde Air Products Co., New York, N. Y. The manufacturer states that the sensitivity of the new extensometer is such that it will indicate the elongation in a standard A.S.T.M. test specimen occasioned by the heat of the hand. The two gage points of the instrument are clamped on the specimen to be tested in such a manner that the elongation between the two points during tension is multiplied five times by a lever bar making electrical contact with a micrometer head. The moment of contact is indicated by the flash of a small electric light in the extensometer head. This feature makes it possible for a single operator to determine both the ultimate strength and the yield point of a specimen. The extensometer may also be used as a strain gage to determine the elongation of a specimen under a specific load.



New extensometer by Linde Air Products Co.

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New Publications

Bulk-Cement Scales. Automatic and semi-automatic scales for weighing bulk cement for highway construction as manufactured by the Richardson Scale Co., Clifton, N. J., are described in bulletins 5132 and 4232, respectively, published by the company. Both types of scales have capacities from 400 lb. to 1,000 lb. The arrangement of the scale permits rapid removal and transportation from one location to another. The scales are built to meet the specifications adopted by the state of New York for the use of bulk cement on state highway construction. The automatic scale is capable of operating at a speed of 2 weighings per minute provided an adequate head of cement is maintained in the storage bin above.

Cement Handling. An 8-page booklet has been issued by Sprout, Waldron & Co., Inc., Muncy, Pa., describing the equipment manufactured by that company for handling bulk cement. The equipment described includes the vertical screw elevator for unloading bulk cement, the Turn-O-Matic cement batch checker, the Monarch 10-bag cement weighing batcher the Monarch-Clark type power shovel, the Monarch standard cement storage bin, and the Monarch cement and stone handling elevator.

Self-Locking Thread. The Dardelet self-locking screw thread is described in a 32-page booklet published by the Dardelet Threadlock Corp., 120 Broadway, New York, N. Y. The self-locking feature involves the use of a thread profile that wedges the bolt and nut together when brought up tight.

Explosives. Principles and practices which have proved successful in accelerated fill settlement operations are discussed in "Use of Explosives for Settling Highway Fills," a 48-page booklet published by the Explosives Department of E. I. Du Pont de Nemours & Co., Wilmington, Del. The subject matter deals with three plans of procedure: The Trench Method, the Under-Fill Method, and the Relief Method. The book is comprehensive within the limits set by the compilers and the text is supplemented with many diagrams and illustrations made from photographs of actual operations.

New Equipment in Brief

Road Grader. A new power-controlled road machine, known as the Sixty Grader, is announced by the Caterpillar Tractor Co., Peoria, Ill. Seven lever controls are provided with control power supplied by a single-cylinder 5 hp. gasoline engine. The controls adjust respectively the height of the right end of the blade, the height of the left end of the blade, the three point control, steering, the lean of the two front wheels, the circle side shift and the lean of the two rear wheels.

Welder. The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., announces a new 100 amp. Flex Arc A-C welder. It is rated at 220-440 volts, 50-60 cycles, single phase with current range of 4 to 125 amperes and is designed for use on thin gauge material.

Plastering Machine. The "Rotor-Mix" equipment announced by the Welded Products Co., 4900 Cecelia St., Bell, Los Angeles, Calif., is a machine for the mechanical placing of concrete coatings and plasters. It depends for mixing and placing upon a rapidly rotating, electrically driven rotor wheel, set in a lightweight gun or nozzle. The complete equipment consists of a rubber tired trailer chassis upon which are mounted the generator, blower, water pump and open hopper. Materials are fed into the hopper and are carried by air pressure through a flexible hose to the nozzle. The mixing nozzle comprises a small electric motor driving the rotor which mixes the water with the plastic materials just before application.

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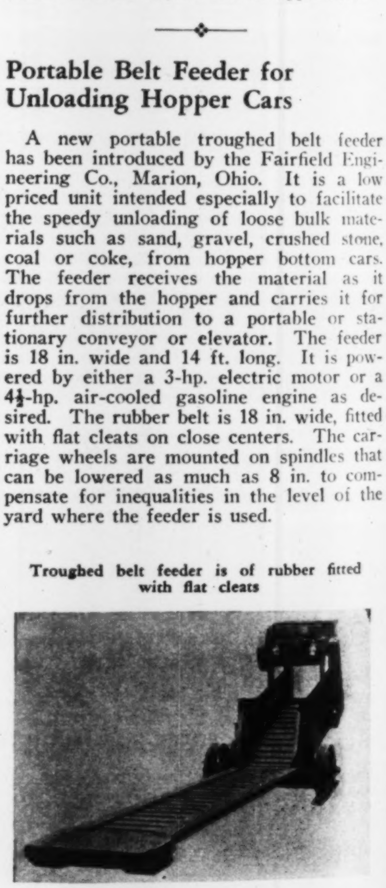
Portable Belt Feeder for Unloading Hopper Cars

A new portable troughed belt feeder has been introduced by the Fairfield Engineering Co., Marion, Ohio. It is a low priced unit intended especially to facilitate the speedy unloading of loose bulk materials such as sand, gravel, crushed stone, coal or coke, from hopper bottom cars. The feeder receives the material as it drops from the hopper and carries it for further distribution to a portable or stationary conveyor or elevator. The feeder is 18 in. wide and 14 ft. long. It is powered by either a 3-hp. electric motor or a $4\frac{1}{2}$-hp. air-cooled gasoline engine as desired. The rubber belt is 18 in. wide, fitted with flat cleats on close centers. The carriage wheels are mounted on spindles that can be lowered as much as 8 in. to compensate for inequalities in the level of the yard where the feeder is used.

Troughed belt feeder is of rubber fitted with flat cleats